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U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY—BULLETIN No. 48.

CATALOGUE

OF

EXHIBITS OF INSECT ENEMIES OF FOREST AND FOREST PRODUCTS

AT THE

LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO., 1904.

PREPARED UNDER THE DIRECTION OF THE ENTOMOLOGIST BY

A. D. HOPKINS,
In Charge of Forest Insect Investigations.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1904.

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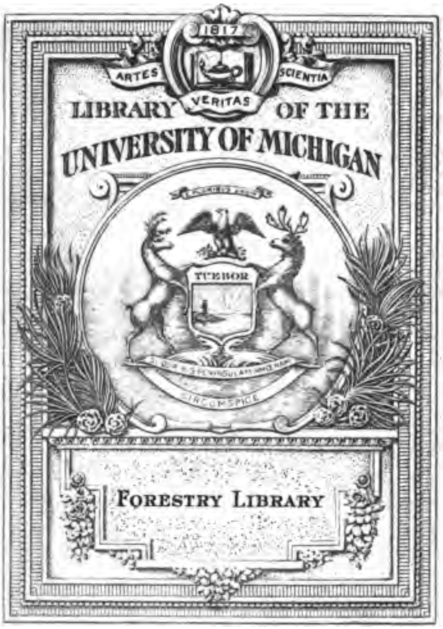
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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Entomology,
Washington, D. C., May 23, 1904.

Sir: I have the honor to transmit herewith manuscript of a catalogue of the exhibit of insect enemies of forests and forest products of the Louisiana Purchase Exposition held at St. Louis, Mo., during the present year. It has been prepared under my direction by Dr. A. D. Hopkins, in charge of Forest Insect Investigations, in the hope of increasing the economic value of the exhibit, and is practically a continuation of the catalogue of the general exhibit which has been published as Bulletin 47 of the present series. The catalogue has been divided into four sections, as fully explained by its author. In the preparation of the exhibit Doctor Hopkins has had the expert assistance of Prof. W. E. Rumsey, of the West Virginia Experiment Station, and, later, of Mr. W. F. Fiske, of this Division, who has also assisted in the preparation of the catalogue. I recommend its publication as Bulletin No. 48 of this Division.

Respectfully,

L. O. Howard,
Entomologist.

Hon. James Wilson,
Secretary of Agriculture.

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CATALOGUE OF EXHIBITS OF INSECT ENEMIES OF FORESTS AND FOREST PRODUCTS AT THE LOUISIANA PURCHASE EXPOSITION.

INTRODUCTORY.

The extent of depredations by insects on the principal kinds of trees in different sections of the country, the magnitude of the problems demanding investigation, and the growing demand for information on causes and remedies led to the establishment of a section of the Division of Entomology for forest-insect investigations, which was organized on July 1, 1902.

The object of this section is to conduct original research in the field and laboratory, to determine the principal insect enemies of forest trees and forest products, and especially to determine facts relating to life histories, habits, distribution, character of injury, and natural enemies on which to base recommendations of methods for preventing losses.

Information acquired from observations by the author in all but one State, relating to the character and extent of the work of insects which are either detrimental or destructive to the forest resources and products of the country, leads him to estimate the average annual losses at $100,000,000. This is based on late stumpage values and wholesale prices of commercial products.

CHARACTER OF THE EXHIBIT.

The object of the exhibit is to show the character of work and injury, the various kinds of insects which cause the injury, and also the kinds which are beneficial on account of their habits of preying upon the injurious ones.

The labels give brief information as to the common or English names and technical or Latin names of insects, followed by brief descriptions of the character of their work, habits, and distribution, and the kinds of trees or wood injured. When the species is of special importance, reference is made to the principal publications concerning them.

In the preparation of sections 2, 3, and 4 of the exhibit, including labels, the author wishes to acknowledge the valuable service of Mr. W. F. Fiske.

The exhibit is in four sections, and consists of fifty-four cases, one large wall case, and a set of photographs. There are in all 789 specimens of insects, 623 specimens of work, and 18 photographs. Sections 1, 2, and 4 are in the Division of Entomology exhibit in the Government Building, while section 3 is in the forestry building, with the Bureau of Forestry exhibit.

Section I.—INSECT ENEMIES OF FORESTS IN THE NORTHWESTERN AND THE NORTHEASTERN STATES.[a]

This exhibit consists of material collected by the author during special investigations for the Division previous to the organization of the forest-insect investigations as a separate section.

The labels are copied in this catalogue with such revisions, corrections, and additional matter as seems necessary.

Reports of the two special investigations, during which the specimens were collected, will be found in Bulletin No. 21, n. s., of the Division of Entomology, entitled, "Preliminary Report on the Insect Enemies of Forests in the Northwest;" and Bulletin No. 28, n. s., "Insect Enemies of the Spruce in the Northeast." The exhibit was prepared by the author, assisted by Mr. W. E. Rumsey, of the West Virginia Experiment Station.

Section II.—INSECT ENEMIES OF FORESTS IN GENERAL.

This section consists of material collected since the 1st of July, 1902, and such other specimens in the general collection of the Division of Entomology and the National Museum as were not represented in the forest insect collections. It will be found in cases 25 to 48, inclusive, and in a large wall case. In this section the transformations and work of several representatives of each class of insects are shown, while other species, having analogous habits and transformations, are represented by the adult insects alone.

Section III.—INSECT ENEMIES OF FORESTS (SPECIAL PROBLEMS UNDER INVESTIGATION, IN COOPERATION WITH THE BUREAU OF FORESTRY).

This section comprises specimens collected by the author and assistants during special investigations of some of the principal depredations by forest insects now attracting attention. It will be found in six large cases, numbered 49 to 54, in the Forestry Building, in connection with the exhibit of the Bureau of Forestry. The exhibit shows the character of work of some of the most destructive enemies of forests and the insects which are responsible for the damage. The labels give general information regarding the insects and their habits, which will aid the forester and the lumberman in recognizing them when met with.

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[a] This exhibit was shown at the Pan-American Exposition, at Buffalo, New York, in 1901, and at the Interstate and West Indian Exposition at Charleston, S. C., in 1901-2.

Section IV.—PHOTOGRAPHS OF INSECT DAMAGE TO FORESTS.

The photographs of insect damage are enlarged from 4 by 5 and 5 by 7 negatives taken by the author and his assistants, and show some of the features of insect work which could not well be represented by specimens.

GENERAL DESCRIPTION OF THE EXHIBIT.

A large amount of the material in the exhibit represents the first of the kind collected, and many of the descriptions of the work, host plants, habits of the insects, etc., on the labels and in this catalogue, are original.

The exhibit represents several quite distinct classes of enemies, as related to orders and groups of insects, the parts of trees attacked, primary or secondary injuries, etc. This is indicated to a certain extent by the arrangement of the specimens in the cases, and by the labels; but in order to prevent duplication in the catalogue, the descriptions of the principal classes of insects and the character of their work are included in the introduction, classified primarily according to the part of the tree or kind of product injured, and secondarily according to the class of insects which have similar habits.

The term "trunk and branches" not only refers to living trees, but to dying, dead, and felled trees, sawlogs, and like crude products.

INSECTS INFESTING THE BARK.

BARK-BEETLES.

[PLATES I-VIII.]

This class of beetles attacks living, dead, and recently felled trees. The parent adults excavate their brood galleries through the inner layers of bark and often groove the outer surface of the wood. Their eggs are deposited along the sides of the galleries and the young broods develop in the bark and transform to the adult either in the bark or outer sapwood. Some of the species attack living trees, causing their rapid death, and are among the most destructive enemies of American forests; others are of secondary importance in attacking the injured trees and contributing to their death, while still others attack only the bark and twigs of dying and dead trees.

BARK AND WOOD BORING GRUBS.

This class of enemies differs from the preceding in the fact that the parent beetles do not burrow into the wood or bark, but deposit their eggs in the surface. The elongate, whitish, round-headed (Cerambycid), flat-headed (Buprestid), or short, stout (Curculionid) grubs hatching from these eggs cause injury by burrowing beneath the bark or deep into the sapwood and heartwood of living, injured, and dead trees, sawlogs, etc. Some of the species infest living trees, causing serious injury or death. Others attack only dead and dying bark and wood, but this injury often results in great loss from the so-called worm-hole defects.

BARK-WEEVILS.

This class of insects includes species which injure and kill the central shoots of pine and spruce, such injury often resulting in deformed and worthless matured trees. Others attack the base of young trees and apparently cause their death, or breed in the bark of injured and dying standing trees, and logs and stumps of those recently felled.

BARK AND WOOD BORING CATERPILLARS.

This class includes the young of clear-winged, wasp-like moths, which mine in the bark and wood of living trees, causing masses of pitch to form over the wound. They often cause serious damage to reproduction and plantations of conifers and other trees.

INFESTING THE WOOD.

AMBROSIA OR TIMBER BEETLES.

This class of insects attack living, dead, and felled trees, sawlogs, green lumber, and stave-bolts, often causing serious injury and loss from the pin-hole and stained-wood defects caused by their brood galleries. The galleries are excavated by the parent beetles in the sound sapwood, sometimes extending into the heartwood, and the young stages feed on a fungous growth which grows on the walls of the galleries.

TIMBER WORMS.

This class of true wood-boring "worms," or grubs, are the larvæ of beetles of the families Lymexylidæ and Brenthidæ. They enter the wood from eggs deposited in wounds in living trees, from which they burrow deep into the heartwood. Generation after generation may develop in the wood of a tree without affecting its life, but the wood is rendered worthless for most purposes by the so-called worm-hole and pin-hole defects resulting from their burrows. The same species also breed in the wood of dying and dead standing trees, and in the stumps and logs of felled ones, often for many years after the trees are felled. One species sometimes attacks freshly sawed oak lumber, new stave bolts, etc. They are among the most destructive enemies of hard-wood forest trees, especially in reducing the value of the wood of the best part of the trunks.

THE CARPENTER WORMS.

These are large pinkish caterpillars which are the larvæ of stout-bodied moths. They enter the bark and wood of living oak, locust, poplar, and other trees from eggs deposited by the moths in the crevices of uninjured bark, or in the edges of wounds. They burrow deep into the solid wood, where they live for two or three years before transforming to the adult. The wood is seriously injured by the very large worm-hole defects, and while the life of the tree is but slightly, if at all, affected by the earlier attacks, the continued operations of this class of borers year after year finally results in the decay of the heartwood, or a hollow trunk and a dead top.

HORN-TAILS.

This is a class of borers which are the larvæ of the so-called wood wasps. They may enter the exposed dead wood of wounds of living trees, but more commonly attack the wood of dead standing conifers and hard woods, in the sapwood of which they excavate irregular burrows, which are packed with their borings. When the adults emerge they leave the surface perforated with numerous round holes. Water and fungi entering these holes cause a very rapid decay of the wood.

POWDER-POST BEETLES.

This is a class of insects representing two or three families of beetles, the larvæ of which infest and convert into fine power many different kinds of dry and seasoned wood products, such as hickory and ash handles, wagon spokes, lumber, etc., when wholly or in part from the sapwood of trees. Oak and hemlock tan bark is sometimes injured to a great extent, and the structural timbers of old houses, barns, etc., are often seriously injured, while hoop poles and like products are attacked by one set of these insects, the adults of which burrow into the wood for the purpose of depositing their eggs.

INSECTS INJURING LEAVES.

THE TRUE CATERPILLARS.

These are the larvæ of butterflies and moths, and include a great variety of forms which feed on the leaves of all kinds of forest trees. Some attack the opening buds, others the very young leaves, while others consume the mature foliage. The greater number cause no perceptible injury, yet there are some, like the forest tent caterpillar, the pine butterfly, the western hemlock span-worm, etc., which are capable of widespread devastation.

FALSE CATERPILLARS.

These are the larvæ of a class of insects which are related to the bees, but have very peculiar habits as compared with other insects of the order (Hymenoptera) to which they belong. The adults are called sawflies, on account of the peculiar saw-like ovipositor, by means of which they make incisions in the living plant tissue for the reception of their eggs. The larvæ are often found in great numbers on pine, dogwood, birch, elm, cultivated currant, etc., completely defoliating the plant in a short time. Some of the species are capable of widespread destruction of certain kinds of trees, as, for example, the larch sawfly (*Nematus erichsonii*), which between 1882 and 1885 destroyed to an alarming extent the eastern larch or tamarac in New England and Canada.

THE LEAF-BEETLES.

This is a class of defoliators of which both the adults and the larvæ feed on the leaves. The willow and elm leaf-beetles are common examples of the more destructive kinds.

GALL INSECTS.

The galls on the leaves of various trees are produced in great variety by several distinct classes of gall-making insects. As a rule, each species, or a class of allied species, make galls of peculiar forms, by which the species or class to which they belong may be identified. Some galls are caused by four-winged gnats of the order Hymenoptera, others of the two-winged gnats of the order Diptera, and still others by plant-lice, Psyllids, etc., of the order Hemiptera.

PLANT-LICE.

This is a class of soft-bodied insects which cluster in great numbers on the leaves, injuring them by sucking out their sap, causing a faded or curled appearance, and often doing serious damage.

INSECTS INFESTING THE TWIGS.

TWIG-BEETLES.

These are small bark-beetles, which confine their operations to the smaller twigs, and either mine under the bark or into the pith. They rarely attack living twigs, but are exceedingly abundant in those of dying and recently felled trees, and may in some cases contribute to the rapid death of trees attacked by other insects.

TWIG-WEEVILS.

This is a class of snout beetles or so-called weevils which deposit their eggs in the living, dying, and dead twigs of trees, and the larvæ mine in the bark and pith. When they infest the twigs of living trees they often do considerable damage.

TWIG CATERPILLARS.

These are the larvæ of moths, which burrow into the terminal twigs of pine and other conifers and often cause serious harm. There are also certain kinds which attack the bark of the twigs and cause masses of pitch to form, in which they live.

SCALE INSECTS.

This is an extensive class of insects which infest the bark of all sorts of trees and are often very injurious. The young, after hatching from the eggs or mother scales, crawl about and attach themselves to the bark by means of their long, slender beaks. Many species exude a kind of wax which forms a scale-like covering which protects them during their period of growth.

PLANT-LICE.

These are similar to the plant-lice which infest the leaves, but certain kinds confine their attack to the twigs, especially some of those belonging to the genus *Lachnus*. Some of them are covered with a cottony or wool-like substance, while others are large, black, and shining.

GALL INSECTS.

There are many kinds of gall insects which produce galls on the twigs of forest trees, and like those causing galls on the leaves represent several orders and families.

CICADAS.

This is a class of insects of which the periodical cicada is a common example. They often cause serious injury to the twigs, which they puncture for the purpose of depositing their eggs.

INSECTS INJURIOUS TO FRUIT OR SEEDS.

This designation refers to insects which attack the young to matured fruit and seeds on the living tree, or after they have fallen.

WEEVILS.

This is a class of snout-beetles which are often very injurious to acorns and various kinds of nuts. The eggs are deposited in the young fruit and the young larvæ live on the inner portion until the nut or fruit has matured and falls to the ground, when they burrow their way out and go into the ground to transform to adults, which come out the next year in time to repeat the operation.

CONE AND NUT WORMS.

The cones and fruit of pine, spruce, and other conifers and nut-bearing trees are often infested by small caterpillars which prevent the development of the cones and seeds.

GALLS.

There are certain gall insects which attack cones and cause a deformed development either of the cone or the seeds.

INSECT INJURY TO FOREST PRODUCTS.

Insects injure various kinds of crude and finished forest products and reduce their value or render them entirely worthless.

INJURY TO FRESHLY CUT PRODUCTS.

This is caused by a class of insects which attack freshly sawed lumber, square timber, stave bolts, etc. (See Timber beetles and Timber worms.)

INJURY TO DRY AND SEASONED PRODUCTS.

This is caused by a class of insects which attack the sapwood of seasoned lumber, handles, spokes, and the like; also tan bark. (See Powder-post beetles.)

BENEFICIAL INSECTS.

Predaceous insects.—This is a class consisting of beetles, wasps, and true bugs, which feed on injurious insects and are often very beneficial in reducing the numbers of some of the more destructive kinds.

Parasitic insects.—This is a class which is represented by the four-winged and two-winged flies, the larvæ of which either live within the bodies of the larvæ and adults of injurious insects or attach themselves to the bodies of the larvæ and pupæ and kill them. This class is a very extensive one, and is of enormous benefit in reducing the numbers and keeping in check the ravages of the destructive species.

METHOD OF PREVENTING LOSSES.

The methods of preventing losses from depredations by forest insects consist mainly in the adoption of improved methods of forest management, based on a knowledge of the life histories and habits of the primary and secondary enemies of the trees and the natural enemies of the insects. Recommendations for the application of any method must be based on a knowledge of the special insect or group of insects found to be primarily to blame for the losses, and must necessarily vary in the details to suit the requirements of local conditions, different kinds of insects, different kinds of trees, and different kinds of forest products; it is therefore difficult and scarcely advisable to give any general recommendations in this connection for preventing losses. This will be brought out in future publications, reports, and special correspondence.

CATALOGUE OF EXHIBIT.

SECTION I.—INSECT ENEMIES OF FORESTS IN THE NORTHWESTERN AND NORTHEASTERN UNITED STATES.
SECTION II.—INSECT ENEMIES OF FORESTS IN GENERAL.
SECTION III.—SPECIAL INVESTIGATIONS.
SECTION IV.—PHOTOGRAPHS.

SECTION I.

INSECT ENEMIES OF FOREST TREES IN THE NORTHWESTERN AND NORTHEASTERN UNITED STATES.

NORTHWESTERN STATES.

INJURY BY AMBROSIA BEETLES. ORDER COLEOPTERA, FAMILY SCOLYTIDÆ.

CASE 1.

1. **The Western Platypus** (*Platypus* n. sp.).

Excavates long, branching galleries in the sapwood and heartwood of injured, dying, and recently felled Douglas spruce, western hemlock, and giant arbor vitæ. California to northern Oregon; also reported from Washington.

EXHIBIT: Adult and work.

2. **Western Hemlock Wood-Stainer** (*Gnathotrichus sulcatus* Lec.).

Excavates numerous branching galleries from a central burrow, the broods living in closely joined side chambers; in the sapwood and heartwood of western hemlock, Douglas spruce, giant arbor vitæ, and grand fir. California to northern Washington; common in hemlock.

EXHIBIT: Adult and work.

3. **The Western Pine Wood-Stainer** (*Gnathotrichus* n. sp.).

Excavates transverse galleries in the surface of the wood and branching ones deep in the sapwood and heartwood, the broods living in short side chambers; western yellow pine and Douglas spruce. Cascade and Rocky Mountain region, California to northeastern Washington.

EXHIBIT: Adult and work.

4. **The Eastern Pine Wood-Stainer** (*Gnathotrichus materiarius* Fitch).

Excavates several branching galleries from a single-entrance burrow, the broods living in short side chambers in sapwood and heartwood of injured, dying, and recently felled pine and spruce. Eastern United States and Canada. Very common and injurious.

EXHIBIT: Adult and work.

5. The Spruce Timber-Beetle (*Trypodendron bivittatus* Kirby).

Excavates several branching galleries from a single entrance burrow, the brood developing in short side chambers in the sapwood of injured, dying, and recently felled spruce, pine, hemlock, cedar, fir, and larch. Eastern, northeastern, and weste United States, Canada, and British Columbia to Alaska; very injurious.

Exhibit: Adult and work.

6. The Birch Timber-Beetle (*Trypodendron* n. sp.).

Excavates branching galleries from an entrance burrow and the broods develop in short side chambers in sapwood and heartwood of paper birch. Kootenai, Idaho, and northwestern Maine; also other birches in Maine.

Exhibit: Adult and work.

7. The Cosmopolitan Timber-Beetle (*Xyleborus saxeseni* Ratz.).

Excavates branching galleries and broad brood chambers from an entrance burrow in sapwood and heartwood of Douglas spruce in Oregon, red oak in Maine, apple and hemlock in West Virginia, and oak, beech, maple, lime tree, poplar, pine, spruce, and fruit trees in Europe. Widely distributed in different countries of the world, especially in Europe, North America, and Japan.

Exhibit: Adult and work.

INJURY BY BARK-BEETLES. ORDER COLEOPTERA, FAMILY SCOLYTIDÆ.

CASE 2.

8. The Hairy Cryphalus (*Cryphalus* n. sp.).

Excavates broad, irregular chambers in dying and dead bark of grand fir. Port Williams, Wash.

Exhibit: Adult and work.

9. The Western Oak Bark-Beetle (*Pityophthorus pubipennis* Lec.).

Excavates two transverse galleries from a central entrance burrow in the bark of injured, dying, and recently felled California black oak, Oregon white oak, and possibly other oaks. California to Oregon.

Exhibit: Adult and work.

10. The Densely-punctured Bark-Beetle (*Pityophthorus confinis* Lec.).

Excavates a large central chamber and several radiating primary galleries with very deep egg cavities in living bark of injured, dying, and recently felled western yellow pine. Northern California, eastern Washington, and western Idaho.

Exhibit: Adult and work.

11. The Lodgepole Pine Bark-Beetle (*Pityophthorus* n. sp.).

Excavates radiating curved longitudinal galleries from a medium-sized central chamber in living bark on large branches of dying lodgepole pine. Eastern Washington.

Exhibit: Adult and work.

12. The Knobcone Pine Bark-Beetle (*Pityophthorus* n. sp.).

Excavates several radiating galleries from a large central chamber in living bark on branches of injured and dying knobcone pine and western yellow pine. Berkeley, Cal., and Albany, Oreg.

Exhibit: Work.

13. The Monterey Pine Twig-Beetle (*Pityophthorus puncticollis* Lec.).

Excavates small radiating, curved, galleries from a large central chamber in twigs and branches of dying and felled Monterey pine, shore pine, western yellow pine, knobcone pine, Sitka spruce, and mountain or silver pine. Middle California to northern Washington.

Exhibit: Adult and work.

14. The Sitka Spruce Twig-Beetle (*Pityophthorus nitidulus* Mann.).

Excavates three or four radiating galleries from a medium-sized central chamber in bark of Sitka spruce, mountain pine, shore pine, and Douglas spruce. California to Alaska, coast and Cascade region. Common.

EXHIBIT: Adult and work.

15. The Jeffrey Pine Twig-Beetle (*Pityophthorus* n. sp.).

Excavates small central chambers and long longitudinal galleries in living bark of twigs and branches on living, injured, dying, and recently felled Jeffrey pine and western yellow pine. Mount Shasta, California, to Albany, Oreg., and Moscow Mountains, Idaho.

EXHIBIT: Adult and work.

16. The Smaller Fir Bark-Beetle (*Pityophthorus* n. sp.).

Excavates transverse galleries from a central chamber in the bark of dying grand fir and mountain or silver pine. Kootenai, Idaho.

EXHIBIT: Adult and work.

CASE 3.

17. The Mountain Pine Wood-Engraver (*Pityogenes* n. sp.).

Excavates large central chambers and numerous curved primary galleries in the bark and surface of wood of injured, dying, and recently felled mountain or silver pine and grand fir. Kootenai, Idaho.

EXHIBIT: Adult and work.

18. The Yellow Pine Wood-Engraver (*Pityogenes carinulatus* Lec.).

Excavates numerous radiating galleries from a large central chamber in living bark and surface of wood of injured, dying, and recently felled western yellow pine and Jeffrey pine. California to eastern Washington, western Idaho, and Colorado.

EXHIBIT: Adult and work.

19. The Western Fir Bark-Beetle (*Tomicus* n. sp.).

Excavates several radiating, curved, transverse galleries from a small central chamber in the bark and surface of wood of injured, declining, or dying grand fir, California white fir. Mount Shasta, California, and Moscow Mountains, Idaho. Common.

EXHIBIT: Adult and work.

20. The Smaller Sugar Pine Tomicus (*Tomicus latidens* Lec.).

Excavates two or three longitudinal galleries from a small central chamber in living bark of branches of dying and recently felled sugar pine. Grants Pass, Oregon; also California to Colorado.

EXHIBIT: Adult and work.

21. The Sitka Spruce Tomicus (*Tomicus concinnus* Mann.).

Excavates irregular central chambers, and three or four short curved galleries, in partly living bark of injured, dying, and recently felled Monterey pine, shore pine, and Sitka spruce. Coast region, middle California to Alaska.

EXHIBIT: Adult and work.

22. The Oregon Tomicus (*Tomicus oregoni* Eichh.).

Excavates two or three longitudinal galleries from a small central chamber in the bark of living, injured, dying, and recently felled western yellow pine, lodgepole pine, silver pine, and probably other pines in the Northwest. Destructive to the western yellow pine in western Idaho.

EXHIBIT: Adult and work.

23. The Western Five-Spined Tomicus (*Tomicus confusus* Lec.).

Excavates one to three long longitudinal galleries from a medium-sized central chamber in the living bark of injured, dying, and recently felled yellow pine. Mount Shasta, California, and Grants Pass, Oregon; also recorded from southern California and Arizona.

EXHIBIT: Adult and work.

CASE 4.

24. The Silver Pine Tomicus (*Tomicus* n. sp.).

Excavates very long, straight, longitudinal, and transverse curved galleries from a large central chamber in the bark of living, injured, dying, and recently felled mountain or silver pine and sugar pine. Grants Pass, Oregon, and Kootenai, Idaho. Common and evidently a destructive species.

EXHIBIT: Adult and work.

25. The Four-Spined Tomicus (*Tomicus integer* Eichh.).

Excavates several longitudinal primary galleries from a large central chamber in living bark of western yellow pine and lodgepole pine. Eastern Washington; also recorded from California, Washington, and Colorado.

EXHIBIT: Adult and work.

CASE 5.

26. The Sugar Pine Wood-Engraver (*Carphoborus* n. sp.).

Excavates several long, curved, longitudinal galleries in the surface of the wood from a deep central chamber in injured or dying sugar pine, yellow pine, Douglas spruce, and Sitka spruce. Grants Pass, St. Helen, and Ahlers, Oregon; also middle California.

EXHIBIT: Adult and work.

27. The Western Cedar Bark-Beetle (*Phlœosinus punctatus* Lec.).

Excavates a single straight longitudinal or curved subtransverse gallery from a basal chamber in the living bark and surface of wood of injured, dying, and recently felled giant arborvitæ, incense cedar, and Port Orford cedar. California to northern and eastern Washington and Rocky Mountain region. Common.

EXHIBIT: Adult and work.

28. The Sitka Spruce Dolurgus (*Dolurgus pumilis* Mann.).

Excavates irregular, confused galleries in dying and dead bark of dead and felled Sitka spruce. Southern and central Oregon.

EXHIBIT: Adult and work.

CASE 6.

29. The Redwood Bark-Beetle (*Phlœosinus sequoiæ* Hopk.).

Excavates a long, straight, longitudinal gallery from a basal chamber in living bark of injured, declining, and recently felled redwood and giant arborvitæ. California to northern Washington. Very common in redwood.

EXHIBIT: Adult and work.

CASE 7.

30. The Western Pine-Destroyer (*Dendroctonus brevicomis* Lec.).

Excavates long, winding galleries through the bark of living and injured western yellow pine and sugar pine. Cascade and Rocky Mountain region, New Mexico to British Columbia. Closely allied with the destructive pine bark-beetle of the East and capable of great destruction of the largest and best timber.

EXHIBIT: Adult and work.

CASE 8.

31. The Dark-Red Turpentine-Beetle (*Dendroctonus valens* Lec.).

The largest North American bark-beetle. Excavates very broad and long primary galleries, the broods developing in broad side chambers in the bark of living, injured, dying, and recently felled yellow pine, lodgepole pine, and doubtless most of the other western pines. California to British Columbia and eastward to Kansas and northern Michigan. A variety extends into the eastern United States. Common and injurious, but not necessarily destructive to living timber.

EXHIBIT: Adult and work.

32. The Mountain Pine Dendroctonus (*Dendroctonus* n. sp.).

A medium-sized black bark-beetle, excavating very long, winding galleries in the bark of living, injured or declining, and recently felled mountain or silver pine and sugar pine. Northern California to Washington eastward to Idaho and Montana. Very common and capable of great destruction of the best timber.

EXHIBIT: Adult and work.

CASES 9 AND 10.

33. The Douglas Spruce Dendroctonus (*Dendroctonus* n. sp.). (*Dendroctonus similis* in Division of Entomology, Bul. 21, n. s.).

A large, reddish bark-beetle, excavating long longitudinal, slightly curved primary galleries in the bark of living, injured, and recently felled Douglas spruce and western larch. New Mexico to British Columbia, Pacific coast and eastward through the mountain regions. Very common and capable of destroying much valuable timber.

EXHIBIT: Adult and work.

CASE 10.

34. The Western Pine Hylurgops (*Hylurgops subcostulatus* Mann.).

Excavates short, slightly curved, longitudinal galleries in the living bark of injured, dying, and recently felled sugar pine, western white pine, western yellow pine, lodgepole pine, and probably other pines on the Pacific coast. Cascade and Rocky Mountain region. Common.

EXHIBIT: Adult and work.

35. The Sitka Spruce Hylurgops (*Hylurgops rugipennis* Mann.).

Excavates a short, curved, longitudinal and subtransverse gallery from an entrance in the living bark of injured, dying, and recently felled Sitka spruce and shore pine. Coast region, California to Washington and Alaska.

EXHIBIT: Adult and work.

CASE 11.

36. The Fir Wood-Engraver (*Hylesinus* n. sp.).

Excavates a small central chamber at one side of the junction of two short transverse, slightly curved egg galleries, which are deeply grooved in the surface of the wood; the larvæ also groove or engrave the surface of the wood in an ornamental manner. Infests the grand fir and Douglas spruce. Port Williams and Port Angeles, Wash. Common.

EXHIBIT: Adult and work.

37. The Larger Fir-Tree Bark-Beetle (*Hylesinus granulatus* Lec.).

Excavates one or two transverse galleries from a central burrow in the bark and surface of wood near the base of dying grand fir. Port Williams, Wash.; also recorded from California.

EXHIBIT: Adult and work.

38. The Grand Fir Bark-Beetle (*Hylesinus* n. sp.).

Excavates two separate, transverse galleries from a central entrance burrow in the bark and surface of wood of recently felled grand fir. Port Angeles and Port Williams, Wash.

Exhibit: Work.

39. The Shore Pine Hylesinus (*Hylesinus sericeus* Mann.).

Excavates one short, longitudinal gallery from the entrance burrow and small side cavity in living bark of injured, dying, and recently felled shore pine. Newport and Seaside, Oreg. Common. Also recorded from California and Alaska.

Exhibit: Adult and work.

40. The Ash-Tree Bark-Beetle (*Hylesinus aculeatus* Say).

Excavates two long, transverse galleries, from a central entrance burrow and side cavity in the living bark of injured, dying, and recently felled ash. Atlantic to Pacific coast. Common. Specimens from Oregon ash, St. Helen, Oreg.

Exhibit: Adult and work.

41. The White-Alder Bark-Beetle (*Hylesinus aspericollis* Lec.).

Excavates a moderately long, longitudinal gallery from a basal entrance burrow in the bark of living, injured, dying, and recently felled white alder. Newport, Detroit, and Astoria, Oreg., and Seattle, Wash.; also recorded from California. A destructive enemy, causing the death of large trees.

Exhibit: Adult and work.

42. The Western Hemlock Bark-Beetle (*Hylesinus* n. sp.).

Excavates one or two transverse galleries from a central burrow in bark and surface of wood of living, injured, and recently felled western hemlock, causing "gum spot" defects in the wood of living trees, and may cause the death of the best timber. Newport, Oreg., and Port Angeles, Wash.

Exhibit: Adult and work.

CASE 12.

43. The Douglas Spruce Hylesinus (*Hylesinus nebulosus* Lec.).

Excavates two short, straight, longitudinal galleries from a central entrance burrow in the living bark of injured, dying, and recently felled Douglas spruce. California to British Columbia, and eastward to Idaho and Colorado. Very common.

Exhibit: Adult and work.

44. The Single Spine Scolytus (*Scolytus unispinosus* Lec.).

Excavates two short, straight, longitudinal galleries from an entrance burrow in living bark of injured, dying, and recently felled Douglas spruce and western larch. Pacific coast, Cascade and Rocky Mountain region. Common.

Exhibit: Adult and work.

45. The Fir-Branch Scolytus (*Scolytus* n. sp.).

Excavates two short, longitudinal galleries from a central burrow and side cavity in living bark of the branches of recently felled grand fir. Cascade Mountains near Grants Pass, Oregon.

Exhibit: Work.

46. The Smaller Fir-Tree Scolytus (*Scolytus* n. sp.).

Excavates two transverse or oblique, slightly curved galleries from a central entrance burrow and side cavity in the bark and surface of wood of injured and dying grand fir. Kootenai, Idaho.

Exhibit: Adult and work.

CASE 13.

47. The California White Fir Scolytus (*Scolytus præceps* Lec.).

Excavates two, nearly straight, transverse galleries from a central entrance burrow and basal cavity in living bark and surface of wood of California white fir. Mount Shasta, California, and grand fir, Sand Point, Idaho. Closely allied in character and habits to No. 48.

EXHIBIT: Adult and work.

48. The Fir Tree Destroyer (*Scolytus subscaber* Lec.).

Excavates two long, nearly straight, transverse galleries from a central entrance burrow and central or side cavity, in bark of living, injured, and declining grand fir, California white fir, and doubtless other species of fir. California to British Columbia, eastern Washington, and western and northern Idaho. The healed-over wounds in living trees cause serious defects and rapid decay of the heartwood.

EXHIBIT: Adult and work.

BARK AND WOOD-BORING GRUBS. ORDER COLEOPTERA, FAMILIES BUPRESTIDÆ AND CERAMBYCIDÆ.

CASE 14, AND PART OF CASE 15.

49. The Douglas Spruce Bark-Borer (*Asemum nitidum* Lec.).

A round-headed, bark-boring grub, boring transverse and winding galleries in the bark of living, injured, and declining Douglas spruce and hemlock. Cascade Mountains, near Detroit, Oreg., St. Helen, Oreg., and Port Williams, Wash. A very common and destructive enemy of the Douglas spruce. The healed-over wounds in the wood cause serious defects, and the trees die from successive attacks.

EXHIBIT: Adult and work.

50. The White-Pine Sawyer (*Monohammus scutellatus* Say.).

A large, whitish round-headed, bark and wood-boring grub, excavating burrows through the sapwood and deep into the heartwood of fire-scorched, declining, dying, dead, and recently felled mountain or silver pine. Kootenai, Idaho, and white pine in eastern and northern United States. Common and destructive.

EXHIBIT: Adult and work.

51. The Ponderous Sawyer (*Ergates spiculatus* Lec.).

An exceedingly large, round-headed, bark and wood-boring grub, excavating large and deep burrows in the sapwood and heartwood of dead and felled western yellow pine; destructive to the wood of timber that has been dead or felled one or more years. Southern Oregon.

EXHIBIT: Adult and work.

52. The Western Cedar Bark-Borer (*Hylotrupes amethystinus* Lec.).

A medium-sized bark and wood-boring grub, excavating long, winding burrows in the living bark and surface of the wood and boring into the sapwood of injured, dying, and recently felled giant arbor vitæ and incense cedar. Northern California to Washington.

EXHIBIT: Work.

53. The Bronze Birch-Borer (*Agrilus anxius* Gory).

A long, flat-headed, slender, wood-boring grub, excavating long, winding burrows in the bark and surface of the wood of living and injured birch and poplar trees in northern Idaho, northern Maine, and mountains of West Virginia; also recorded from northern Michigan, New York, Pennsylvania, Virginia, Quebec, and Ontario. A destructive enemy of the birches and poplar.

EXHIBIT: Adult and work.

INJURY BY GALL INSECTS. ORDER HYMENOPTERA.

PART OF CASE 15.

54. Bird's-eye Pine (*Chalcidid?*).

A common condition of the wood of the western yellow pine evidently caused by a minute four-winged gnat, fragments of which were found in pitch galls in the bark of the main stem of young living pine. The formation of corky wood cells around the accumulation of pitch in the wound produces in the subsequent layers of wood the wavy and so-called birds-eye effect in the wood of larger trees. Insects found in specimen at Albany, Oreg. Specimen of wood from Grants Pass, Oreg.

EXHIBIT: Work.

55. The Oak-Twig Ormyrus (*Ormyrus* sp.).

A minute four-winged gnat breeding in small gall-like cavities in the living bark on the branches and twigs of the Oregon white oak in western Oregon, causing the small and large oak trees to present a dying appearance, due to the great number of dying twigs and dead leaves. The healed-over wounds produce deformed branches and defective wood.

EXHIBIT: WORK.

INJURY BY BARK AND WOOD-BORING GRUBS. ORDER COLEOPTERA, FAMILY BUPRESTIDÆ.

CASE 16.

56. The Western Hemlock Bark-Borer (*Melanophila drummondi* Kirby).

A medium-sized, flat-headed, bark-boring grub, excavating shallow, winding burrows through the inner layers of bark of living, injured, and recently felled western hemlock and Douglas spruce; California to northern and eastern Washington and western Idaho, and in the noble fir near Detroit, Oreg. A very common and destructive enemy, killing the largest and best trees, or causing serious "gum spot" defects in the wood of living ones.

EXHIBIT: Adult and work.

INJURY BY BARK-WEEVILS. ORDER COLEOPTERA, FAMILY CURCULIONIDÆ.

PART OF CASE 17.

57. The Sugar Pine Bark-Weevil (*Pissodes* sp.).

Adult snout-beetle deposits eggs in the outer bark of young living and injured sugar pine, producing small whitish grubs which mine through the inner bark and change to the adult in oval cavities excavated in the surface of the wood, causing the death or abnormal development of the trees. Grants Pass, Oreg.

EXHIBIT: Work.

58. The Douglas Spruce Twig-Weevil (*Curculionid*).

A small snout-beetle which deposits eggs in cavities in the bark of the small central shoots and terminal twigs of young, living Douglas spruce. The small whitish grubs mine through the inner bark and enter the pith to change to the adult, killing the twigs and causing a deformed development of the tree. St. Helen, Oreg.

EXHIBIT: Work.

59. The Pine Fungus-Gall Weevil (*Curculionid*).

A small snout-beetle breeding in the bark and wood of a common fungus gall on the shore pine and western yellow pine, causing the death of the branches and young trees. Newport, Oreg., and Moscow Mountains, Idaho.

EXHIBIT: Work.

INJURY TO DEAD WOOD AND BARK BY POWDER-POST BEETLES. ORDER COLEOPTERA, FAMILY PTINIDÆ.

PART OF CASE 17.

60. The Pine Wood Perforator (*Ptinid ?*).

Small white grubs burrow through the dead wood of western yellow-pine logs, causing rapid decay. Grants Pass, Oreg.

EXHIBIT: Work.

61. The Giant Arbor Vitæ Ptinid (*Ptinid*).

Small white grubs boring in the dead heartwood of living giant arborvitæ, contributing to the rapid decay of the heartwood. Port Angeles, Wash.

EXHIBIT: Work.

62. The Giant Arbor Vitæ Dryophilus (*Dryophilus* sp.).

A small whitish grub and brownish beetle, breeding in the outer bark of the giant arborvitæ. Its work is very common. Detroit, Oreg., and Port Angeles, Wash. "Represents a European family and genus heretofore unrecorded from North America." (Schwarz.)

EXHIBIT: Work.

INJURY TO TWIGS BY BARK MAGGOT. ORDER DIPTERA, FAMILY CECIDOMYIIDÆ.

PART OF CASE 17.

63. The Pine Twig Maggot (*Cecidomyiid*).

Minute reddish maggot, living in the bark of terminal twigs of the western yellow pine, causing the leaves to turn yellow and die. Moscow Mountains, Idaho. Common.

EXHIBIT: Work.

INJURY BY GALL INSECTS. ORDER HEMIPTERA, FAMILY APHIDIDÆ.

CASE 18.

64. The Sitka Spruce Gall-Louse (*Chermes sibiricus ?*).

A minute insect forming cone-like galls on the terminal twigs of the Sitka spruce at Newport, Oreg. Very common and injurious to young trees.

EXHIBIT: Work.

65. The Englemann Spruce Gall-Louse (*Chermes sibiricus ?*, var.).

Same habit as 64, but probably a variety or different species. Common on Englemann spruce at Sand Point, Idaho.

EXHIBIT: Work.

INJURY BY CICADA. ORDER HEMIPTERA, FAMILY CICADIDÆ.

CASE 18.

66. Small Western Cicada (*Cicada* sp.).

Injuring twigs of Douglas spruce, St. Helen, Oreg.

EXHIBIT: Adult and work.

INJURY BY TWIG-MINER. ORDER LEPIDOPTERA, FAMILY TORTRICIDÆ.

CASE 18.

67. The Pine Twig-Miner (*Tortricid*).

A caterpillar of a moth with similar habits to that of the pine moth of Nantucket, excavating burrows through the pith of the terminal twigs and shoots of young western yellow pine. Moscow Mountains, Idaho, where it was common and quite injurious.

EXHIBIT: Work.

NORTHEASTERN STATES.

INJURY BY BARK AND TWIG-BEETLES. ORDER COLEOPTERA. FAMILY SCOLYTIDÆ.

CASE 19.

68. The Balsam Fir Cryphalus (*Cryphalus* n. sp.).

Excavates irregular, broad, elongate egg chambers to one side of the entrance burrow in the bark and surface of wood, the larval galleries radiating in all directions and deeply grooved in the surface of the wood of the branches of dying and dead balsam fir. Shores and islands of Parmacheene Lake and Rump Mountain, Maine.

EXHIBIT: Work.

69. The Spruce Cryphalus (*Cryphalus* n. sp.).

Excavates broad transverse egg chambers in the bark and surface of wood; the larval galleries but slightly grooved in the surface of the wood of dying and dead red spruce and balsam fir. Islands and shores of Parmacheene Lake and near Portland, Me. Common in bark of small dying and dead red spruce.

EXHIBIT: Adult and work.

70. The Minute Oak Bark-Beetle (*Pityophthorus minutissimus* Zimm.).

Excavates two straight transverse galleries from a central entrance burrow and elongate longitudinal chamber in the bark and surface of wood of branches on living, dying, and felled trees, rarely in the thicker bark on the main trunk, of red oak, southern Maine, and other oaks in the eastern United States.

EXHIBIT: Adult and work.

71. The Minute Birch Bark-Beetle (*Pityophthorus* n. sp.).

Excavates galleries like that of the minute oak bark-beetle (70) in the living and dying bark of branches of the paper birch. Southern Massachusetts.

EXHIBIT: Adult and work.

72. The White Pine Twig-Beetle (*Pityophthorus* n. sp.).

Excavates several long, winding galleries from a central chamber in the bark; deeply grooved in the surface of the wood of small dying and broken branches of white pine. Camp Caribou, Maine.

EXHIBIT: Adult and work.

73. The Minute Spruce-Twig Wood-Engraver (*Pityophthorus* n. sp.).

Excavates a large central chamber and several curved galleries in the bark and deeply grooved in the surface of the wood of small branches of felled red spruce. Shores of Barkers Lake, Maine, and West Virginia.

EXHIBIT: Work.

74. The Spruce Wood-Engraver (*Pityophthorus cariniceps* Lec.).

Excavates many short, radiating, curved galleries from a large central chamber in the bark and surface of the wood of twigs and branches of dying trees and main stem of young, dying red spruce. Western Maine to Morgantown, W. Va., and Detroit, Mich.

EXHIBIT: Adult and work.

75. The Black Spruce Wood-Engraver (*Pityophthorus* n. sp.).

Excavates short longitudinal galleries from the entrance burrow in the bark and surface of wood of small, dying black spruce. Shores of Parmacheene Lake, northwestern Maine; Peakes Island, in Casco Bay, Maine, and Adirondacks, New York.

EXHIBIT: Adult and work.

76. The White Pine Wood-Engraver (*Pityogenes* n. sp.).

Excavates numerous short, radiating, curved egg galleries from a large central chamber in the bark and surface of wood of large and small branches and small, dying white pine. Northern Maine to West Virginia. Common. Heretofore recognized as *Pityophthorus sparsus* Lec.

EXHIBIT: Adult and work.

CASE 20.

77. The Small Red Spruce Bark-Beetle (*Dryocœtes* n. sp.).

Excavates three or four short, curved galleries from a small central cavity in the bark and surface of the wood of injured, dying, and recently felled red, white, and black spruce, Maine to northern New York, and the red spruce in the mountains of West Virginia. Common.

EXHIBIT: Adult and work.

78. The American Spruce Bark-Beetle (*Dryocœtes* n. sp.).

Excavates short, irregular galleries in the living bark of injured, dying, and recently felled red, white, and black spruce in Maine, spruce and pine in West Virginia; also in spruce and pine in Europe. Widely distributed in Europe and eastern North America.

EXHIBIT: Adult and work.

79. The Birch Bark-Beetle (*Dryocœtes* n. sp.).

Excavates irregular galleries in the bark of living, injured, and dying birch. Northwestern Maine and mountains of West Virginia. Common. Under favorable conditions causes the death of large trees.

EXHIBIT: Adult and work.

80. The Balsam Fir Bark-Beetle (*Tomicus balsameus* Lec.).

Excavates several radiating, curved, transverse galleries from a small central chamber in the living and dying bark of injured and dying balsam fir and red and black spruce. Western Maine; also recorded from northern Michigan and New York.

EXHIBIT: Adult and work.

81. The White Spruce Bark-Beetle (*Tomicus* n. sp.).

Excavates several long, radiating, longitudinal egg galleries from a large central chamber in the living bark of recently felled white spruce. Near Camp Caribou, northwestern Maine.

EXHIBIT: Adult and work.

82. The Hudson Bay Tomicus (*Tomicus* n. sp.).

Excavates one or two longitudinal primary galleries from a central burrow and small central chambers in the living bark of recently felled white and red spruce. Northwestern Maine; also recorded from Canada and British Columbia.

EXHIBIT: Adult and work.

CASE 21.

83. The Spruce Bark-Beetle (*Polygraphus rufipennis* Kirby).

Excavates three or four short, curved egg galleries from a large central chamber in the surface of the inner bark, through the bark and slightly grooving the surface of the wood of injured, declining, dying, and recently felled black, red, and white spruce, and rare in balsam fir. Very common throughout the northern and Appalachian spruce regions.

EXHIBIT: Adult and work.

84. The Cedar Bark-Beetle (*Phlœosinus dentatus* Lec.).

Excavates a single short longitudinal egg gallery from the entrance burrow and basal chambers, in the bark and surface of wood of injured and dying juniper and eastern arborvitæ. Eastern and northwestern United States and Canada. Common.

EXHIBIT: Adult and work.

86. The Parmacheene Bark-Beetle (*Xylochinus* n. sp.).

Excavates short, irregular egg galleries in the dead bark of small red spruce and balsam fir. Islands of Parmacheene Lake, Maine.

EXHIBIT: Work.

87. The Red Spruce Scolytus (*Scolytus* n. sp.).

Excavates two longitudinal egg galleries from a central entrance burrow and small lateral cavity in the living bark of branches of dying and recently felled red spruce. Northwestern Maine and Peak's Island, near Portland, Me.

EXHIBIT: Adult and work.

CASE 22.

88. The Minute Spruce Bark-Beetle (*Crypturgus atomus* Lec.).

Enters the galleries of other bark-beetles, from which it excavates numerous very small, irregular galleries through the inner bark of dying and dead black and red spruce and white pine. Northwestern Maine.

EXHIBIT: Adult and work.

89. The Spruce-Destroying Beetle (*Dendroctonus piceaperda* Hopk.).

Excavates long, longitudinal egg galleries from a basal entrance burrow in the bark, and grooving the wood of living and injured red and white spruce trees. Very destructive to the largest and best timber. Northern Maine to New York and New Brunswick. This is the great enemy of the red and white spruce of the northeastern spruce region, having caused the death and loss of a vast amount of timber. For methods of preventing losses, see Bulletin 28, n. s., Division of Entomology, U. S. Department of Agriculture.

EXHIBIT: Adult and work.

ENEMIES OF BARK-BEETLES. BIRDS AND INSECTS.

PART OF CASE 23.

90. Work of woodpeckers in spruce bark, when infested with the spruce-destroying beetle.

These birds are exceedingly beneficial in destroying the greatest enemy of the spruce.

EXHIBIT: Work.

91. The Cloudy Bark-Beetle Destroyer (*Thanasimus nubilus* Kl.).

The adults feed on the adults of the spruce-destroying and other bark-beetles, and its young or larvæ prey upon their developing broods. Very beneficial. The specimen of bark shows the pupa case of the Clerid in an egg gallery of the spruce-destroying beetle.

EXHIBIT: Adult and work.

92. Polyporus volvatus Peck.

A fungus growing from entrance and exit burrows of the spruce-destroying beetle in the bark, and the spruce-timber beetle in the wood, and from those of other bark and wood boring insects in dying and recently dead spruce trees killed by the spruce-destroying beetle in the Northeast, and the fir-destroying scolytus in the Northwest. The presence of this fungus usually indicates the destructive work of insects.

EXHIBIT: Work.

93. Parasitic Enemy of the Spruce-Destroying Beetle (*Bracon simplex* Cress).

The adult deposits eggs in the bark with the developing brood of the bark-beetle; the young maggot-like larvæ feed upon and kill the young. Very common and beneficial. Maine to West Virginia. Also attacks numerous other bark-infesting insects. The bark specimen shows the cocoon in which the matured larva develops to the adult.

EXHIBIT: Adult and work.

INJURY BY BARK AND WOOD BORING GRUBS. ORDER COLEOPTERA, FAMILIES BUPRESTIDÆ, CERAMBYCIDÆ, AND MELANDRYIDÆ.

CASE 24.

94. Buprestid.

Work of flat-headed bark and wood miner in wood of dying balsam fir.

EXHIBIT: Work.

95. The Destructive Spruce-Wood Borer (*Tetropium cinnamopterum* Kirby).

A slender, round-headed, bark and wood boring grub which excavates winding burrows through the inner bark and surface of the wood, then enters the sapwood and changes to the adult. Infests slightly injured, declining, and recently felled red, black, and white spruce. Maine to West Virginia. Common, and very destructive to the wood of dying trees, and may also cause the death of slightly injured ones.

EXHIBIT: Adult and work.

96. The Cedar Tree Borer (*Hylotrupes ligneus* Fab.).

A slender, whitish, bark and wood boring grub, excavating winding burrows in the bark and surface of the wood of living arborvitæ, causing the death of the trees, and serious defects in the wood of living ones. Common in northwestern Maine.

EXHIBIT: Adult and work.

97. The Blazed-Tree Borer (*Serropalpus varbatus* Schall).

A slender, whitish, wood-boring grub, which enters at wounds on living trees and bores deep into the sapwood and heartwood, causing a rapid decay of the infested parts. Common in "blazed" wounds on balsam fir and spruce trees along the trails in northwestern Maine.

EXHIBIT: Work.

98. The Mountain Ash Borer (*Saperda* sp.).

A destructive enemy of the mountain ash, boring in the healthy wood of the main stem. Northwestern Maine.

EXHIBIT: Work.

SECTION II.

INSECT ENEMIES OF FORESTS IN GENERAL.

INJURING THE FOLIAGE.

CATERPILLARS OF BUTTERFLIES AND MOTHS. ORDER LEPIDOPTERA.

CASE 25.

99. The Violet-Tip Butterfly (*Grapta interrogationis* Fab.).

Larvæ on elm.

EXHIBIT: Adults, larva.

100. The Mourning Cloak Butterfly (*Euvanessa antiopa* Linn.).

Larvæ on foliage of elm, willow, and poplar, sometimes defoliating trees.

EXHIBIT: Adults, larvæ and pupa.

101. The Viceroy Butterfly (*Basilarchia archippus* Cram.).

Larvæ on willow and poplar.

EXHIBIT: Adult.

102. The Buff-Tipped Butterfly (*Limenitis bredowii* Hüb.).

Larvæ on oak in California.

EXHIBIT: Adult.

103. **The Common Hackberry Butterfly** (*Chlorippe celtis* Bd. & Lec.).
Larvæ on hackberry.
Exhibit: Adult, pupa.

104. **The Pine Butterfly** (*Neophasia menapia* Feld.).
Larvæ defoliate pine in the Pacific States.
Exhibit: Adults.

105. **The Locust Leaf Folder** (*Epargyreus* (*Eudamus*) *tityrus* Fab.).
Larvæ on locust.
Exhibit: Adults, larva, pupa, cocoon.

106. **The Walnut Sphinx** (*Cressonia juglandis* S. & A.).
Larvæ on hickory and walnut.
Exhibit: Adults.

107. **The Pine Sphinx** (*Lapara coniferarum* S. & A.).
Larvæ on pine in the Eastern States.
Exhibit: Adults, larva.

108. **The Catalpa Sphinx** (*Ceratomia catalpæ* Bd.).
The larvæ feed upon and frequently defoliate catalpa wherever this tree is native.
Exhibit: Adult, larva.

109. **The Wavy Ash Sphinx** (*Ceratomia undulosa* Walk.).
Larvæ on ash.
Exhibit: Adult, larva.

110. **The Ash Sphinx** (*Hyloicus kalmiæ* S. & A.).
Larvæ on ash in the Eastern States.
Exhibit: Adult.

CASE 26.

111. **The Four-Horned Sphinx** (*Ceratomia amyntor* Hüb.).
Larvæ on elm.
Exhibit: Adults, larva.

112. **The Western Poplar Sphinx** (*Pachysphinx modesta* var. *occidentalis* Hy. Edw.).
Larvæ on poplar in the Western States.
Exhibit: Adult.

113. **The Polyphemus Moth** (*Telea polyphemus* Cram.).
The large green larvæ occur on maple, oak, birch, and a variety of other forest trees.
Exhibit: Adult.

114. **The Hickory Horned Devil** (*Citheronia regalis* Hüb.).
Larvæ on hickory and walnut.
Exhibit: Adults, larva.

115. **The Imperial Moth** (*Basilona imperialis* Dru.).
The larvæ feed upon pine and many other species of coniferous and deciduous trees.
Exhibit: Adults, larva, pupa.

116. **The Orange-Striped Oak Worm** (*Anisota senatoria* Hübn.).
The larvæ defoliate oak in the Eastern States.
Exhibit: Adults, larvæ, pupæ.

117. **The Spiny Oak Worm** (*Anisota stigma* Hübn.).
Larvæ in large colonies on oak, sometimes defoliating trees. Eastern States.
Exhibit: Adults, larvæ, pupæ.

CASE 118.

118. The Green-Striped Maple Worm (*Anisota rubicunda* Fab.).
Larvæ in colonies on maple, sometimes defoliating trees. Eastern States.
EXHIBIT: Adults, eggs, larvæ, pupæ.

119. The Buck Moth (*Hemileuca maia* Dru.).
The black spiny larvæ feed in colonies on oak. Eastern States.
EXHIBIT: Adults.

120. The Pale Tussock Caterpillar (*Halisidota tessellaris* Harris).
The pale-yellow, black tufted larvæ feed on elm, sycamore, maple, walnut, oak, etc.
EXHIBIT: Adults.

121. The Pine Tussock Caterpillar (*Euschausia argentata* Pack.).
The larvæ feed in colonies on pine, cedar, Douglas spruce, etc. Northwestern States.
EXHIBIT: Adults, pupæ, cocoon, work.

122. The Hickory Tussock Caterpillar (*Halisidota caryæ* Harris).
The white wooly caterpillars, tufted with black, feed in large colonies on hickory, walnut, elm, and other forest trees, sometimes becoming very destructive. Eastern States.
EXHIBIT: Adults, cocoons.

123. The Oak Tussock Caterpillar (*Halisidota maculata* Harris).
The orange and black tufted larvæ on oak, elm, alder, etc. Northern States.
EXHIBIT: Adults.

124. The Fall Web-Worm (*Hyphantria textor* Harris).
Larvæ construct large tents on most species of deciduous forest trees. At times very destructive.
EXHIBIT: Adults, larvæ, pupa.

125. The American Dagger-Moth (*Apatela americana* Harr.).
The larvæ occur on maple, elm, and a variety of other forest trees.
EXHIBIT: Adults, larva.

126. The Smeared Dagger-Moth (*Apatela oblinita* S. & A.).
Larvæ occur on nearly all varieties of deciduous trees.
EXHIBIT: Adults, larvæ.

CASE 28.

127. The Underwing Moths (Genus *Catocala*).
The large gray larvæ of these moths, of which there are many species in the United States, are nocturnal in habit, and conceal themselves during the day in the crevices of the bark on tree trunks and limbs. They devour the foliage of oak, hickory, walnut, poplar, birch; and other species of forest trees.
EXHIBIT: Adults of the following species: *Catocala retecta* Grote, *Catocala vidua* S. & A., *Catocala obscura* Strk., *Catocala cerogama* Guen., *Catocala unijuga* Walk., *Catocala concumbens* Walk., *Catocala cara* Guen.

128. The Semi-Looping Maple Worm (*Homoptera lunata* Dru.).
The slender green larvæ occur on maple, willow, etc.
EXHIBIT: Adults, larva, pupa.

129. The California Phryganidia (*Phryganidia californica* Pack.).
Larvæ on oak, sometimes defoliating trees in California.
EXHIBIT: Adults, larvæ.

130. The Poplar Tent-Maker (*Melalopha inclusa* Hübn.).
Larvæ construct small tents on poplar and willow. Eastern States.
EXHIBIT: Adults, larva.

131. The Black Hickory Caterpillar (*Datana integerrima* G. & R.).
Larvæ in colonies on hickory and walnut, sometimes defoliating the trees. Eastern States.
EXHIBIT: Adult, larva, pupæ.

132. The Yellow-Necked Apple-Tree Caterpillar (*Datana ministra* Dru.).
Larvæ in colonies on birch, oak, and other forest trees, as well as on apple. Eastern States.
EXHIBIT: Adults, eggs, larvæ, pupa.

133. The Striped Hickory Caterpillar (*Datana angusii* G. & R.).
Larvæ in colonies on hickory and oak. Eastern States.
EXHIBIT: Adults.

134. The Green Oak Caterpillar (*Nadata gibbosa* S. & A.).
Larvæ on oak, maple, and other forest trees.
EXHIBIT: Adult, larvæ.

135. The Rosy Hyparpax (*Hyparpax aurora* S. & A.).
Larvæ on oak in the Eastern States.
EXHIBIT: Adults.

CASE 29.

136 The Red-Humped Oak Caterpillar (*Symmerista albifrons* S. & A.).
Larvæ on oak, sometimes defoliating trees in the Eastern States.
EXHIBIT: Adults, larva, pupa.

137. The Rusty Tussock-Moth (*Notolophus antiqua* Linn.).
Larvæ on most species of deciduous forest trees in America and Europe.
EXHIBIT: Adults.

138. The California Tussock-Moth (*Hemerocampa vetusta* Bd.).
Larvæ on various species of deciduous forest trees in California.
EXHIBIT: Adults, larva.

139. The White-Marked Tussock-Moth (*Hemerocampa leucostigma* S. & A.).
Larvæ sometimes defoliate elm, maple, and other deciduous forest trees in the Eastern States.
EXHIBIT: Adults, egg-mass, larva, cocoon.

140. The Dark Tussock-Moth (*Olene achatina* S. & A.).
Larvæ on various deciduous forest trees in the Eastern States.
EXHIBIT: Adult.

141. The Brown-Tailed Moth (*Euproctis chrysorrhœa* Linn.).
Introduced from Europe and destructive to deciduous forest trees in Massachusetts and New Hampshire.
EXHIBIT: Adults.

142. The Gypsy Moth (*Porthetria dispar* Linn.).
Introduced from Europe and very destructive to nearly all deciduous and a few coniferous forest trees in Massachusetts.
EXHIBIT: Adults, larvæ.

143. The Forest Tent-Caterpillar (*Malacosoma* (*Clisiocampa*) *disstria* Hübn.).
Larvæ at times very destructive to maple, oak, poplar, gum, and nearly all other deciduous forest trees throughout the United States.
EXHIBIT: Adults, eggs, larvæ, pupa, cocoons.

144. The Tufted Tent-Caterpillar (*Malacosoma* (*Clisiocampa*) *constricta* Stretch).
Larvæ on oak in California.
EXHIBIT: Adults, eggs, larvæ.

145. The American Tent-Caterpillar (*Malacosoma* (*Clisiocampa*) *americana* Fab.).

Larvæ principally destructive to fruit trees, but also to cherry and a few other forest trees in the Eastern States.

EXHIBIT: Adults, eggs.

146. The Rocky Mountain Tent-Caterpillar (*Malacosoma* (*Clisiocampa*) *fragilis* Stretch.).

Larvæ feed on deciduous forest trees generally and are at times very destructive. Rocky Mountain States.

EXHIBIT: Adults, eggs, larvæ.

147. The Northwestern Tent-Caterpillar (*Malacosoma* (*Clisiocampa*) *pluvialis* Dyar.).

Larvæ on most species of deciduous forest trees in the Northwestern States.

EXHIBIT: Adults, larva, cocoon.

148. The Californian Tent-Caterpillar (*Malacosoma* (*Clisiocampa*) *californica* Pack.).

Larvæ on oak in California.

EXHIBIT: Adults, larva.

149. The Spring Canker-Worm (*Paleacrita vernata* Harr.).

The larvæ feed upon the surface of the leaves of various forest and shade trees; especially upon elm in the Eastern States.

EXHIBIT: Adults, pupa.

CASE 30.

150. The Cherry-Leaf Web-Worm (*Calocalpe undulata* Linn.).

The larvæ live in webs on the terminal shoots of black cherry.

EXHIBIT: Adults, work.

151. The Western Oak Span-Worm (*Therina somniaria* Hulst.).

The larvæ occur on oak in the Northwestern States, sometimes defoliating trees.

EXHIBIT: Adults, pupæ.

152. The Large Forest Span-Worm (*Sabulodes transversata* Dru.).

Larvæ occur on maple, poplar, oak, etc.

EXHIBIT: Adults, larva.

153. The Crinkly Flannel Moth (*Lagoa crispata* Pack.).

The larvæ, which somewhat resemble the slug caterpillars, feed upon oak, poplar, and a variety of other deciduous trees.

EXHIBIT: Adults.

154. The Oak Web-Worm (*Archips* (*Cacœcia*) *fervidana* Clem.).

Larvæ live in colonies on oak, sheltered by a web inclosing leaves and a mass of excrement.

EXHIBIT: Adults.

155. The Slug Caterpillars (Family *Cochlidiidæ*.).

These bright-colored slug-like larvæ feed very generally on foliage of most deciduous trees.

EXHIBIT: the following species: *Sibine stimulea* Clem., adults, larva, cocoon; *Euclea delphinii* Bdv., adult; *Euclea indetermina* Bdv., adult.

THE FALSE CATERPILLARS OR SAWFLIES. FAMILY TENTHREDINIDÆ.

PART OF CASE 31.

156. Abbott's White-Pine Sawfly (*Lophyrus abbotti* Leach).

This species, together with several closely allied forms, is at times very destructive to pine.

EXHIBIT: Adults, larvæ, cocoons.

157. The Larch Sawfly (*Nematus erichsonii* Hartig).

One of the most destructive forest insects; the larvæ at various times past entirely defoliated the larch throughout the Northeastern States and caused the death of a large proportion of the trees.

EXHIBIT: Adults.

158. The Large American Sawfly (*Cimbex americana* Leach).

Larvæ destroy foliage of elm, willow, poplar, and linden.

EXHIBIT: Adult.

MISCELLANEOUS FOLIAGE INSECTS.

PART OF CASE 31.

159. The Common Walking Stick (*Diapheromera femorata* Say).

Young and adults devour foliage of deciduous forest trees.

EXHIBIT: Adult.

160. The Katydid (*Microcentrum laurifolium* Linn.).

Young and adults feed on foliage of trees.

EXHIBIT: Adult, eggs.

LEAF-BEETLES. FAMILY SCARABÆIDÆ.

161. The Rhinoceros Beetle (*Dynastes tityus* Linn.).

Larvæ mine in decaying stumps; adults destroy foliage of ash.

EXHIBIT: Adults.

162. The Goldsmith Beetle (*Cotalpa lanigera* Linn.).

Adults on oak, poplar, and other deciduous trees, sometimes defoliating them.

EXHIBIT: Adults.

THE LEAF-BEETLES. FAMILY CHRYSOMELIDÆ.

PART OF CASE 31.

163. The Imported Elm Leaf-Beetle (*Galerucella luteola* Müll.).

A very serious enemy to the elm in the Eastern States.

EXHIBIT: Adults, work.

164. The Larger Elm Leaf-Beetle (*Monocesta coryli* Say).

Adults and larvæ destroy foliage of elm in sections of the Middle West.

EXHIBIT: Adults, work.

165. The Striped Willow Leaf-Beetle (*Melasoma scripta* Fab.).

Both larvæ and adults feed on foliage of poplar and willow, and are at times very destructive to these trees. An especial enemy of the osier willow industry.

EXHIBIT: Adults, pupæ.

166. The Spotted Willow Leaf-Beetle (*Melasoma lapponica* Linn.).

Habits similar to the above, but less abundant and injurious.

EXHIBIT: Adults.

INJURING THE FRUIT.

THE WEEVILS. FAMILY CURCULIONIDÆ.

PART OF CASE 31.

167. The Nut Weevils (Genus *Balaninus*).

There are numerous species, the larvæ of which live within acorns and nuts of various sorts.

EXHIBIT: Adults of the following species: *Balaninus nasicus* Say, *Balaninus caryæ* Horn, *Balaninus quercus* Horn.

168. The Walnut Fruit Weevil (*Conotrachelus juglandis* Lec.).

The larvæ live in green fruit of walnut.

EXHIBIT: Adults.

CONE AND NUT WORMS. ORDER LEPIDOPTERA.

PART OF CASE 31.

169. The Hickory Husk-Worm (*Grapholitha caryana* Fitch).

The larvæ live within the immature nuts and husks of the hickory and pecan.

EXHIBIT: Adults, work.

170. The Spruce Cone-Worm (*Pinipestis reniculella* Grt.).

Larvæ attack cones of spruce.

EXHIBIT: Adult, work.

171. The Southern Pine Cone-Worm.

An insect closely allied to the spruce cone-worm which attacks the cone of the Southern long-leaf pine.

EXHIBIT: Work.

INJURING THE TWIGS AND SMALLER BRANCHES.

THE CICADAS. FAMILY CICADIDÆ.

PART OF CASE 31.

172. The Seventeen-Year Cicada (*Tibicen septendecim* Linn.).

The most destructive species, but owing to the long period required by the young to reach maturity only injurious some years.

EXHIBIT: Adults, pupa, work.

THE SCALE INSECTS. FAMILY COCCIDÆ.

PART OF CASE 31.

173. The Cottony Maple Scale (*Pulvinaria innumerabilis* Rath.).

Becomes at times very abundant on twigs of maple.

EXHIBIT: Adult scales on twigs.

174. The Gloomy Maple Scale (*Aspidiotus tenebricosus* Comst.).

At times very abundant on maple. Principally injurious to shade trees in the neighborhood of towns.

EXHIBIT: Adult scales on bark.

175. The Hickory Soft Scale (*Lecanium* sp.).

At times abundant on hickory and pecan in the Southern States.

EXHIBIT: Adult scales on twigs.

THE TWIG WEEVILS. FAMILY CURCULIONIDÆ.

PART OF CASE 32.

176. The Western Spruce Weevil (*Pissodes* sp.).
Attacks and kills the terminal shoots of Sitka spruce, causing deformed trees. Northwestern States.
EXHIBIT: Adults, larvæ, work.

177. The White-Pine Weevil (*Pissodes strobi* Peck.).
Attacks and kills the terminal shoots of white pine, spruce, and deodar, causing serious deformity to the tree; also breeds in the bark of the lower portions of the trunk of pines and spruce, hastening the death of injured trees. Eastern States.
EXHIBIT: Adults, work. Sections of young white pine showing nature of injury to terminal shoots. (Large case.)

ROUND-HEADED BORERS. FAMILY CERAMBYCIDÆ.

PART OF CASE 32.

178. The Oak Pruner (*Elaphidion villosum* Fab.).
The larvæ bore in twigs of living oak, hickory, etc., causing them to break and fall.
EXHIBIT: Adults, work.

179. The Hickory Twig Girdler (*Oncideres cingulata* Say).
The adult girdles the twigs of oak, hickory, persimmon, and other trees, sometimes so extensively as to cause serious injury.
EXHIBIT: Adults, work, figure.

INJURING THE INNER BARK AND SAPWOOD.

THE BARK WEEVILS. FAMILY CURCULIONIDÆ.

CASE 33.

180. The Cypress Weevil (*Eudocimus mannerheimii* Boh.).
The adults feed on the bark of bald-cypress twigs, causing their death, and the larvæ mine the inner bark of injured and recently felled trees. Southern States.
EXHIBIT: Adult, larva, work.

181. The Pales Weevil (*Hylobius pales* Hbst.).
The larvæ bore into the inner bark of stumps and roots of recently felled, dying, and injured pine. Eastern States.
EXHIBIT: Adults.

182. The Pitch-Eating Weevil (*Pachylobius picivorus* Germ.).
Has habits similar to the pales weevil. Eastern States.
EXHIBIT: Adults.

183. The Walnut Weevil (*Cryptorhynchus parochus* Hbst.).
The larvæ mine the inner bark and sapwood of weakened and recently dead walnut.
EXHIBIT: Adults, work.

184. The Fir Weevil (*Pissodes dubius* Rand.).
The larvæ mine the inner bark of balsam fir, hastening the death of injured trees. Northeastern States.
EXHIBIT: Adults, larvæ, work.

THE ROUND-HEADED BORERS. FAMILY CERAMBYCIDÆ.

CASE 34.

185. The White-Pine Sawyer (*Monohammus scutellatus* Say).

Larvæ mine the inner bark and bore deep into the sapwood of white and silver pine, hastening the death of dying trees and injuring saw logs.

EXHIBIT: Adults, work.

186. The Common Pine Sawyer (*Monohammus confusor* Kirby).

The larvæ mine the inner bark and bore large holes into the sapwood of dying trees and saw logs of pine and spruce.

EXHIBIT: Adults, larva.

187. The Ponderous Pine-Borer (*Ergates spiculatus* Lec.).

Larvæ bore in dead pine logs, injuring them for timber. Northwestern States.

EXHIBIT: Adults, larva, work.

188. The Knob-Horned Pine-Borer (*Acanthocinus nodosus* Fab.).

The larvæ mine the inner bark of pine stumps and large logs.

EXHIBIT: Adults.

189. The Obsolete Pine-Borer (*Acanthocinus obsoletus* Oliv.).

The larvæ mine the inner bark of freshly killed pine.

EXHIBIT: Adults.

190. The Small Pine Bark-Borer (*Ceratographis pusillus* Kirby).

Larvæ mine the inner bark of dead and dying pine.

EXHIBIT: Adults.

191. The Lesser Pine Borer (*Asemum mœstum* Hald.).

Larvæ bore into sapwood of dead pine and spruce logs and stumps. Eastern States.

EXHIBIT: Adults.

CASE 35.

192. The Poplar Borer (*Saperda calcarata* Say).

Larvæ bore in trunks of living poplar, cottonwood, and willow, causing great destruction to these trees.

EXHIBIT: Adults, work.

193. The Common Elm-Tree Borer (*Saperda tridentata* Oliv.).

The larvæ mine the bark and sapwood of dead, dying, and healthy elm, often causing great destruction.

EXHIBIT: Adults, work.

194. The Poplar Girdler (*Saperda concolor* Lec.).

Larvæ mine in green bark of poplar saplings, girdling the trunks and causing large swellings; also attack willow.

EXHIBIT: Adults, work.

195. The Sugar Maple Borer (*Plagionotus speciosus* Say).

Larvæ mine the inner bark and sapwood of recently dead, dying, and living maple, often causing the death of weakened trees.

EXHIBIT: Adults.

196. The Locust Borer (*Cyllene robiniæ* Forst.).

Larvæ mine the wood and bark of living black locust, causing great damage and destruction.

EXHIBIT: Adults, work.

197. The Linden Borer (*Saperda vestita* Say).
Larvæ mine the inner bark and bore into the trunk of linden, causing much injury.
EXHIBIT: Adults, work.

198. The Chestnut Callidium (*Callidium æreum* Newm.).
Larvæ mine inner bark of chestnut, hastening, and perhaps causing, death of aged or injured trees.
EXHIBIT: Adults, larvæ, pupa.

199. The Belted Chion (*Chion cinctus* Dru.).
The larvæ mine the inner bark and bore into the wood of trunk and branches of dying and recently dead hickory, chestnut, oak, etc.
EXHIBIT: Adults, larva, work.

200. The Dusty Oak Borer (*Romaleum atomarium* Dru.).
Larvæ in stumps and logs of recently dead oak.
EXHIBIT: Adults.

CASE 36.

201. The Beautiful Hickory Borer (*Goes pulchra* Hald.).
Larvæ bore in hickory.
EXHIBIT: Adults.

202. The Tiger Hickory Borer (*Goes tigrina* DeG.).
Larvæ mine the inner bark and sapwood of living hickory and oak.
EXHIBIT: Adults.

203. The White-Lined Cypress Borer (*Physocnemum andreæ* Hald.).
Larvæ mine the inner bark and outer sapwood of cypress logs. Southern States.
EXHIBIT: Adults, larva, work.

204. The Common Hickory Borer (*Saperda discoidea* Fab.).
Larvæ mine the inner bark of injured, dying, and recently dead hickory.
EXHIBIT: Adults.

205. The Blue-Winged Walnut Borer (*Gaurotes cyanipennis* Say).
Larvæ infest walnut.
EXHIBIT: Adults.

206. The Lichen-like Beetle (*Leptostylus aculiferus* Say).
Larvæ mine the inner bark of dying and dead tulip (*Liriodendron*).
EXHIBIT: Adults.

207. The Ash-Colored Mulberry Borer (*Hetœmis cinerea* Oliv.).
Adults feed on the foliage and larvæ mine the green bark and sapwood of dying and injured mulberry.
EXHIBIT: Adults.

208. The Painted Hickory Borer (*Cyllene picta* Dru.).
Larvæ bore in the trunks of dead, dying, and sometimes healthy hickory trees.
EXHIBIT: Adults.

CASE 37.

209. The Curious Cypress Borer (*Curius dentatus* Newm.).
Larvæ mine the smaller branches of young bald cypress.
EXHIBIT: Adults, work.

210. The Banded Ash Borer (*Neoclytus capræa* Say).
Larvæ very injurious to dying trees and saw logs of black ash, boring numerous holes through the wood.
EXHIBIT: Adults, work.

211. The Rigid Cypress Borer (*Œme rigida* Say).
Larvæ mine inner bark of girdled cypress and dying cedar.
Exhibit: Adult, larva, work.

212. The Southern Oak Borer (*Mallodon dasystomus* Say).
Larvæ bore in healthy live-oak, hackberry, and hickory trees, greatly injuring them. Southern States.
Exhibit: Adults.

213. The Live-Oak Root-Borer (*Mallodon melanopus* Linn.).
Larvæ bore into the roots of young oaks, causing dwarfed and worthless trees. Southern States.
Exhibit: Adult.

214. The Variable Oak Borer (*Phymatodes variabilis* Fab.).
Larvæ mine inner bark of dying and recently dead oak; are also injurious to tan bark.
Exhibit: Adult, work.

215. The Thunderbolt Beetle (*Arhopalus fulminans* Fab.).
Larvæ mine the inner bark and sapwood of chestnut and oak.
Exhibit: Adults.

216. The Lesser Prionus (*Orthosoma brunneum* Forst.).
Larva in decaying logs and stumps of nearly all forest trees.
Exhibit: Adults.

217. The Cottonwood Root-Borer (*Plectrodera scalator* Fab.).
Larvæ in roots of poplar and cottonwood.
Exhibit: Adults.

218. The Broad-Necked Prionus (*Prionus laticollis* Dru.).
Larvæ in roots of oak and poplar. Sometimes destructive. Also in stumps of pine.
Exhibit: Adults.

CASE 38.

219. The Destructive Spruce Wood-Borer (*Tetropium cinnamopterum* Kirby).
Larvæ mine green bark and wood of injured and dying spruce, hastening death and promoting decay.
Exhibit: Adults, larvæ, work.

220. The Wavy Spruce Borer (*Xylotrechus undulatus* Say).
Larvæ mine the inner bark and sapwood of Douglas spruce, fir, and hemlock.
Exhibit: Adults.

221. The Canadian Leptura (*Leptura canadensis* Fab.).
Larvæ mine sapwood of dead spruce and hemlock, inducing rapid decay.
Exhibit: Adults.

222. The Red-Headed Clytus (*Neoclytus erythrocephalus* Fab.).
Larvæ mine in dead and dying bark and sapwood of a great variety of forest trees, maple, ash, hickory, sweet-gum, cypress, etc.
Exhibit: Adults.

223. The Ribbed Pine Borer (*Rhagium lineatum* Oliv.).
Larvæ mine the inner bark of dying and dead pine, spruce, and some other conifers.
Exhibit: Adults, larvæ, pupa, work.

224. The Black-Horned Pine Borer (*Callidium antennatum* Newm.).
Larvæ mine inner bark and wood of dying and dead pine, cedar, etc.
Exhibit: Adults, work.

225. The Four-Marked Ash Borer (*Eburia quadrigeminata* Say).
Larvæ invest ash and hickory.
Exhibit: Adults.

226. The Cedar Borer (*Hylotrupes ligneus* Fab.).
Larvæ mine inner bark and sapwood of cedar, causing the death of the trees.
Exhibit: Adults, larvæ pupa, work.

227. The Banded Urographis (*Urographis fasciatus* Horn).
The larvæ mine the inner bark of dead oak, maple, chestnut, sweet-gum, hickory, walnut, sourwood, dogwood, and probably nearly all deciduous trees. Eastern States.
Exhibit: Adults.

228. The Rustic Borer (*Xylotrechus colonus* Fab.).
Larvæ mine the inner bark and sapwood of recently cut or dying oak, chestnut, hickory, maple, and other hard woods.
Exhibit: Adults.

THE FLAT-HEADED BORERS. FAMILY BUPRESTIDÆ.

CASE 39.

229. The Bronze Birch Borer (*Agrilus anxius* Gory).
The larvæ mine the inner bark of living and injured birch and poplar. Very destructive in the Northern States.
Exhibit: Adults, work.

230. The Two-Lined Chestnut Borer (*Agrilus bilineatus* Web.).
The slender larvæ mine the inner bark of recently dead, injured, and healthy chestnut and oak. One of the principal causes for the wholesale destruction of chestnut in the Southern States.
Exhibit: Adults, work.

231. The Eastern Hemlock Bark-Borer (*Melanophila fulvoguttata* Harr.).
Larvæ mine the inner bark of recently dead and injured hemlock in the Eastern States.
Exhibit: Adults, work.

232. The Flat-Headed Apple-Tree Borer (*Chrysobothris femorata* Fab.).
The larvæ mine the inner bark of recently dead and injured oak, chestnut, hickory, maple, and some other deciduous forest trees. Eastern States.
Exhibit: Adults, larvæ, pupæ, work.

CASE 40.

233. The Flat-Headed Pine Bark-Borer (*Chrysobothris dentipes* Germ.).
Larvæ mine the inner bark of recently dead and dying pine.
Exhibit: Adults.

234. The Flat-Headed Hickory Borer (*Dicerca obscura* Fab.).
Larvæ bore into the trunk and limbs of hickory, maple, and some other deciduous trees.
Exhibit: Adults.

235. The Western Hemlock Bark-Borer (*Melanophila drummondi* Kirby).
The larvæ mine the inner bark of dead and healthy hemlock and Douglas spruce, causing defects in the lumber and killing trees. Northwestern States.
Exhibit: Adults, larva, pupa, work.

INJURING THE WOOD.

THE FLAT-HEADED BORERS. FAMILY BUPRESTIDÆ.

PART OF CASE 40.

236. The Turpentine Borer (*Buprestis apricans* Hbst.).

The larvæ bore into the solid resinous heartwood of long-leafed pine after "boxing" by turpentine workers, so weakening the trunk as to cause it to break and spoiling portions of it for lumber.

EXHIBIT: Adult, work.

237. The Golden Buprestis (*Buprestis aurulenta* Linn.).

Larvæ bore into trunks of dead pine, spruce, fir, and other conifers.

EXHIBIT: Adults.

238. The Heart-wood Pine Borer (*Chalcophora virginiensis* Dru.).

Larvæ bore into trunks of dead pine and spruce and into heartwood of living trees.

EXHIBIT: Adults, work.

WALL CASE.

239. The Cypress Sapwood Borer (*Acmæodera pulchella* Hbst.).

Larvæ mine the sapwood of girdled cypress several years after death.

EXHIBIT: Work. Cypress board showing injury to the sapwood (large case).

THE TIMBER BEETLES. FAMILY SCOLYTIDÆ.

PART OF CASE 41.

240. The Hickory Timber-Beetle (*Xyleborus celsus* Eich.).

The adults excavate long branching galleries in dying trees and logs of hickory.

EXHIBIT: Adults, work.

WALL CASE.

241. The Pan-American Platypus (*Platypus compositus* Say).

The adults bore into the sapwood and sometimes into the heartwood of dying hardwoods and coniferous trees of numerous species.

EXHIBIT: Work. Boards from girdled cypress showing pin-hole defects caused by the galleries.

THE POWDER-POST BEETLES. FAMILY PTINIDÆ.

PART OF CASE 41.

242. The Red-Shouldered Ptinid Borer (*Sinoxylon basilare* Say).

Adult bores short curved galleries in branches of dead hickory, persimmon, and most other deciduous trees; the larvæ bore the solid wood.

EXHIBIT: Adults, work.

243. Powder-Post Beetles (Genus *Lyctus*).

EXHIBIT: Work, sections of seasoned ash and hickory showing characteristic injury by the beetles and larvæ. (Large case.)

THE TIMBER WORMS. FAMILIES BRENTHIDÆ AND LYMEXYLIDÆ.

PART OF CASE 41.

244. The Northern Brenthis (*Eupsalis minuta* Dru.).

The larvæ excavate extensive galleries in solid wood of recently dead and dying oak, chestnut, beach, elm, cypress, and most other species of deciduous forest trees.

EXHIBIT: Adults, work.

245. The Chestnut Timber Worm (*Lymexylon sericeum* Harr.).

The larvæ excavate extensive galleries in the heartwood and sapwood of living and dead chestnut and oak.

EXHIBIT: Adult, work.

THE CARPENTER WORMS. ORDER LEPIDOPTERA. FAMILY COSSIDÆ.

CASE 42.

246. The Leopard Moth (*Zeuzera pyrina* Fab.).

An introduced species very injurious to forest, shade, and orchard trees in the vicinity of New York City.

EXHIBIT: Adults, larvæ, pupa, work.

247. The Oak Carpenter Worm (*Prionoxystus robiniæ* Peck).

The larvæ mine in living oak and locust and are sometimes very destructive, especially to aged trees.

EXHIBIT: Adults, work.

248. The Poplar Carpenter Worm (*Cossus centerensis* Lint.).

The larvæ mine in trunks of poplar.

EXHIBIT: Adults.

THE HORNTAILS OR WOOD WASPS. FAMILY URÒCERIDÆ.

CASE 43.

249. The Pigeon Tremex (*Tremex columba* Linn.).

Larvæ mine the sapwood of hickory, oak, poplar, maple, and other deciduous forest trees, hastening the death of those weakened by other causes.

EXHIBIT: Adults, work.

250. The Pale Tremex (*Tremex sericeus* Say).

Habits like the pigeon tremex.

EXHIBIT: Adults.

251. The White-Horned Horntail (*Urocerus albicornis* Fabr.).

Attacks spruce, hemlock, and fir.

EXHIBIT: Adults, larva, pupa, work.

252. The Blue Horntail (*Paururus cyaneus* Fab.).

Attacks spruce and fir.

EXHIBIT: Adult.

253. The Banded Horntail (*Urocerus abdominalis* Harris).

Attacks spruce.

EXHIBIT: Adults.

254. The Yellow-Winged Horntail (*Urocerus flavipennis* Kirby).

Attacks spruce.

EXHIBIT: Adults.

255. The Small-Pine Horntail (*Paururus pinicola* Ashm.).

Larvæ in pine.

EXHIBIT: Adults.

256. The Black-Pine Horntail (*Paururus hopkinsi* Ashm.).

Larvæ in pine.

EXHIBIT: Adults.

PARASITIC ENEMIES. FAMILY ICHNEUMONIDÆ.

PART OF CASE 43.

257. The Lunated Long-Sting (*Thalessa lunator* Fab.).

There are several quite similar species of these insects, which by means of the long, thread-like appendage to the body, deposit their eggs within the galleries of the horntail larvæ upon which their own larvæ are parasitic.

Exhibit: Adults.

INJURING INNER BARK.

THE BARK-BEETLES. FAMILY SCOLYTIDÆ.

CASE 44.

258. The Pine-Destroying Beetle of the Black Hills (*Dendroctonus ponderosæ* Hopk.).

Attacks healthy pine and spruce in the Black Hills of South Dakota, and Rocky Mountain region. The adult beetles excavate characteristic galleries in the inner bark of dead, dying, and healthy trees. Their eggs are deposited along the sides of these galleries, and the larvæ developing from them mine the inner bark. It is estimated that it has been the primary cause of the destruction of 1,000,000,000 feet of bull pine (*Pinus ponderosa*) in the Black Hills.

Exhibit: Adults, work. Sections of trunks of western yellow pine attacked by beetles showing pitch tubes on surface and marks of galleries in inner bark. (Large case.)

CASE 45.

259. The Destructive Pine Bark-Beetle (*Dendroctonus frontalis* Zimm.).

Attacks healthy pine and spruce in the Southern States. It is capable of enormous destruction and, though usually held in check by natural causes, has at various times past so increased as to seriously menace the entire stand of pine and spruce in portions of the Southeastern States, notably in West Virginia in 1891–92.

Exhibit: Adults, work. Markings on surface of wood of beetle-killed tree; appearance of outer bark of beetle-killed trees; outer bark of tree scaled off by woodpeckers in search of beetles and their larvæ. (Large case.)

260. The Oregon Tomicus (*Tomicus oregoni* Eich.).

A secondary enemy of pine, attacking and hastening the death of trees primarily attacked by the pine-destroying beetle.

Exhibit: Work. Section of top of western yellow pine, showing galleries of adult beetles in inner bark. (Large case.)

261. The Companion Bark-Beetle (*Tomicus avulsus* Eich.).

A common species infesting pine in the Southern States. When abundant it attacks and kills healthy trees, but is especially common as a secondary enemy in company with the destructive bark-beetle *Dendroctonus frontalis* Zimm.

Exhibit: Adults, work.

CASE 46.

262. The Lawson Cypress Bark-Beetle (*Phlœosinus cupressæ* Hopk.).

Attacks transplanted Lawson and Monterey cypress in California. It also attacks redwood.

Exhibit: Adults, work.

263. The Hickory Bark-Beetle (*Scolytus quadrispinosus* Say).

A common bark-beetle in hickory, frequently causing the death of trees. The adults also do some damage by gnawing the base of small twigs, causing their death.

Exhibit: Adults, work.

CASE 47.

264. The Mountain-Pine Dendroctonus (*Dendroctonus* n. sp.).

Attacks living, injured, and recently felled mountain or silver pine, sugar pine, and lodge-pole pine in the Northwestern States. Very common and capable of great destruction to the best timber.

EXHIBIT: Adults, work.

265. The Arizona Dendroctonus (*Dendroctonus* n. sp.).

A common bark-beetle in the southern Rocky Mountain region, attacking healthy western yellow pine, and, in company with several closely allied species, causing great destruction of large quantities of the best timber.

EXHIBIT: Adults, work.

266. The Bald Cypress Bark-Beetle (*Phlœosinus* n. sp.).

Attacks recently felled and girdled bald cypress in the Southern States.

EXHIBIT: Adults, work.

PREDACEOUS AND PARASITIC ENEMIES OF DESTRUCTIVE FOREST INSECTS. THE CLERIDS. FAMILY CLERIDÆ.

CASE 48.

267. The Dubius Clerid (*Thanasimus dubius* Fab.).

The beetles destroy the adults, and the larvæ prey upon the developing broods of many species of bark-beetles in pine and spruce, and are frequently of the greatest benefit in holding in check the more destructive of these.

EXHIBIT: Adults.

268. The Spider-like Clerid (*Clerus sphegeus* Fab.).

The adults feed upon the adults and the larvæ upon the developing broods of numerous destructive bark-beetles in pine, spruce, and fir. Western States.

EXHIBIT: Adults.

269. The European Bark-Beetle Destroyer (*Thanasimus formicarius* Linn.).

Is very destructive to bark-beetles infesting pine and spruce in Europe, and was introduced into America in 1892 to act as a check to the alarming increase of the destructive bark-beetle (*Dendroctonus frontalis*) in West Virginia.

EXHIBIT: Adults.

270. The Orange-Banded Clerid (*Clerus ichneumoneus* Fab.).

The larvæ prey upon the developing broods of the hickory bark-beetle (*Scolytus quadrispinosus*).

EXHIBIT: Adults.

271. The Hairy Clerid (*Chariessa pilosa* Forst.).

The larvæ prey upon and do much toward preventing the increase of several of the destructive flat-headed borers (*Buprestidæ*) in deciduous trees.

EXHIBIT: Adults.

THE CLICK BEETLES. FAMILY ELATERIDÆ.

272. The Eyed Elater (*Alaus oculatus* Linn.).

As a larva preys upon numerous species of bark and wood boring insects in deciduous trees.

EXHIBIT: Adults.

273. The Small-Eyed Elater (*Alaus myops* Fab.).

As a larva preys upon the larger species of borers in coniferous trees.

EXHIBIT: Adults, larva.

274. The Four-Winged Parasites (Order *Hymenoptera.* Families *Ichneumonidæ, Braconidæ, Chalcididæ,* etc.).

Exhibit: Two larval galleries of the rigid cypress borer (*Œme rigida*), in one of which the insect attained full development, while in the other it was attacked and killed by a parasite, *Bracon* sp.

Adults and cocoons of several species which attack larvæ of butterflies and moths.

Adults and cocoons of several species which attack larvæ of wood-boring insects.

THE TROGOSITIDS. FAMILY TROGOSITIDÆ.

275. The Green Trogositid (*Trogosita virescens* Fab.).

A very important enemy of nearly all the larger and more destructive bark-beetles. The adults conceal themselves in the outer bark, and the larvæ enter the galleries and prey upon the insects therein.

Exhibit: Adults.

THE COLYDIIDS. FAMILY COLYDIIDÆ.

276. The Tuberculate Colydiid (*Aulonium tuberculatum* Lec.).

The adults enter the galleries and with the larvæ feed upon various species of bark-beetles in all their stages.

Exhibit: Adults.

277. The Line-Marked Colydiid (*Colydium lineola* Say).

The adults enter the galleries and their larvæ feed upon the developing brood of various species of Ambrosia beetles.

Exhibit: Adults.

SECTION III.

SPECIAL INVESTIGATIONS.

[In connection with the exhibit of the Bureau of Forestry.]

DESTRUCTION OF PINE BY BARK-BEETLES IN THE BLACK HILLS FOREST RESERVE, SOUTH DAKOTA.

CASE 49.

278. The Pine-Destroying Beetle of the Black Hills (*Dendroctonus ponderosæ* Hopk.).

Attacks healthy pine and spruce in the Black Hills of South Dakota, and Rocky Mountain region. The adult beetles excavate characteristic galleries in the inner bark of dead, dying, and healthy trees. Their eggs are deposited along the sides of these galleries, and the larvæ developing from them mine the inner bark. Very destructive.

Exhibit: Adults, larvæ, pupæ, pitch tube on bark of living tree at entrance to gallery of adult beetle; completed galleries of adults and mines of young larvæ in bark of living pine, showing characteristic appearance of bark in August of the year of attack; surface of wood grooved by galleries of the adult, showing characteristic appearance in August of the year of attack; gallery of adult, larval mines, and pupal chambers in inner bark, showing characteristic appearance in June of the year following attack; appearance of inner bark in August of the year following attack, after the emergence of the brood; scoring chip from railroad cross-tie from tree killed by beetles, showing characteristic markings on surface of wood.

279. The Yellow-Pine Wood Engraver (*Pityogenes carinulatus* Lec.).

A secondary enemy of pine. Attacks branches and twigs of trees dying from attack of the pine-destroying beetle.

EXHIBIT: Adults; work of adults and larvæ in bark and surface of wood.

280. The Oregon Tomicus (*Tomicus oregoni* Eich.).

A secondary enemy of pine forests in the Black Hills, attacking the larger branches and upper portions of the trunks of trees injured by or dying from an attack of the pine-destroying beetle. Occasionally a primary enemy of living trees.

EXHIBIT: Adults; galleries of Oregon Tomicus and pine-destroying beetle side by side in bark of pine; work of adults in bark; groovings in surface of wood.

DESTRUCTION OF PINE FORESTS BY BARK-BEETLES IN THE SOUTHERN STATES.

CASE 50.

281. The Destructive Pine Bark-Beetle (*Dendroctonus frontalis* Zimm.).

Attacks healthy pine and spruce in the Southern States. It is capable of enormous destruction and, though usually held in check by natural causes, has at various times past so increased as to seriously menace the entire stand of pine and spruce in portions of the Southeastern States, notably in West Virginia in 1891–92.

EXHIBIT: Adults; markings on surface of wood of beetle-killed tree; appearance of outer bark and surface of wood of beetle-killed tree; section of trunk of pine, showing galleries of adult beetles in bark two to three weeks after first attack, surface of wood marked by galleries of adult beetles and mines of larvæ six to eight weeks after attack, outer bark of tree scaled off by woodpeckers in search of beetles and their larvæ; work of adults and larvæ in bark.

282. The Companion Bark-Beetle (*Tomicus avulsus* Eich.).

A common species infesting pine in the Southern States. When abundant it may attack and kill healthy trees, but is especially common as a secondary enemy in company with the destructive pine bark-beetle.

EXHIBIT: Adults; appearance of work of adults and larvæ in bark; galleries of destructive pine bark-beetle and companion bark-beetle side by side in bark of large beetle-killed tree.

DESTRUCTION OF WESTERN YELLOW PINE BY BARK-BEETLES IN THE SOUTHERN ROCKY MOUNTAIN REGION.

CASE 51.

283. The Arizona Dendroctonus (*Dendroctonus* n. sp.).

A common bark-beetle in the southern Rocky Mountain region attacking healthy western yellow pine, and in company with several closely allied species causing destruction of large quantities of the best timber.

EXHIBIT: Adults; work of adults and larvæ in bark.

284. The Colorado Dendroctonus (*Dendroctonus approximatus* Dietz).

Attacks recently-dead and living western yellow pine in the southern Rocky Mountain region. Often found working in the same tree and side by side with the Arizona Dendroctonus.

EXHIBIT: Adult; surface of wood showing marks of work; gallery of adult and mines of young larva in bark.

285. The Pine-Destroying Beetle of the Black Hills (*Dendroctonus ponderosæ* Hopk.).

EXHIBIT: Adults; surface of wood showing characteristic groovings; gallery of adult and mines of young larvæ in bark.

INJURY BY BARK-BEETLES TO PINE AND OTHER CONIFERS IN THE NORTHWEST.

CASE 52.

286. The Mountain Pine Dendroctonus (*Dendroctonus* n. sp.).

Attacks living, injured, and recently felled mountain or silver pine, sugar pine, and lodge-pole pine in the Northwestern States. Very common and capable of great destruction to the best timber.

EXHIBIT: Adults; work of adults and larvæ in bark; surface of wood showing characteristic marks of work.

287. The Douglas Spruce Dendroctonus (*Dendroctonus* n. sp.).

Attacks living, injured, and recently felled Douglas spruce and western larch. Rocky Mountain region and Pacific coast. Very common and capable of destroying much valuable timber.

EXHIBIT: Adults; gallery of adult and mines of young larvæ in bark; inner bark of tree showing characteristic appearance of larval mines.

288. The Redwood Bark-Beetle (*Phlœosinus sequoiæ* Hopk.).

Attacks living, injured, and recently felled redwood and giant arborvitæ. California to northern Washington. Very common in redwood.

EXHIBIT: Adults; surface of wood grooved by adult galleries and larval mines.

289. The Lawson Cypress Bark-Beetle (*Phlœosinus cupressæ* Hopk.).

Attacks transplanted Lawson and Monterey cypress in California. It also attacks redwood.

EXHIBIT: Adult; section of small beetle-killed Lawson cypress, showing beginning of gallery of adult in living tree; section of small Lawson cypress showing characteristic grooves in surface of wood, and exit holes of beetles in bark; branch of Monterey cypress showing grooves in surface of wood of adult and larval galleries.

INJURIES BY AMBROSIA OR TIMBER BEETLES.

CASE 53.

290. The Apple Wood-Stainer (*Pterocyclon mali* Fitch.).

A small timber beetle first described from the apple, but attacking a great diversity of woods. It has proven very injurious to the wood of girdled cypress trees and sawed mahogany lumber. In its work in mahogany it is accompanied by the oak wood-stainer (*Pterocyclon fasciatum*), a closely allied species with similar habits.

EXHIBIT: Adults; cypress lumber showing pin-hole defects caused by adults; mahogany lumber seriously injured by the apple wood-stainer and oak wood-stainer; cross section of mahogany plank, showing single gallery of the oak wood-stainer.

291. The Pan-American Platypus (*Platypus compositus* Say).

A timber beetle causing injury to the wood of a great variety of trees and the principal cause of pin-holes in cypress. It attacks girdled trees before cutting.

EXHIBIT: Adults; cypress lumber showing injury in sapwood (pin-holes usually accompanied by staining). Cypress lumber showing injury to heartwood (pin-holes not accompanied by staining).

292. The Sugar-Cane Ambrosia Beetle (*Xyleborus* n. sp.).

An extremely common species throughout the southern United States, West Indies, and Mexico. It attacks a great variety of woods and is also an enemy of sugar-cane, excavating its galleries in living stalks.

EXHIBIT: Adult; injury to wood of cypress logs after cutting and before being sawed, showing entrance galleries on surface of wood and galleries in sapwood; injury to mahogany logs before, during, and after importation; injury to mahogany caused by entrance of beetles at end of logs.

293. The Large Mahogany Timber Beetle (*Platypus* sp.).

Attacks mahogany trees and saw logs before importation.

Exhibit: Work.

INSECTS INFESTING CYPRESS.

CASE 54.

294. The White-Lined Cypress Borer (*Physocnemum andreæ* Hald.).

Larvæ mine the inner bark and outer sapwood of cypress logs. Southern States.

Exhibit: Adults; larva; gallery; complete larval mine on surface of wood of girdled cypress tree.

295. The Rigid Cypress Borer (*Œme rigida* Say).

Larvæ mine inner bark of girdled cypress and dying cedar.

Exhibit: Adult; larva; work; larval mines in bark of girdled cypress.

296. The Bald Cypress Bark-Beetle (*Phlœosinus* n. sp.).

Attacks recently felled and girdled bald cypress in the Southern States; beneficial to girdled trees as it hastens death and causes the logs to dry more rapidly.

Exhibit: Adults; inner bark from girdled cypress, showing characteristic galleries of adults and larvæ.

297. The Cypress Sapwood Borer (*Acmæodera pulchella* Hbst.).

A white grub which mines the sapwood of girdled cypress two or three years after death, causing rapid decay.

Exhibit: Adult; larva; work.

298. The Cypress Weevil (*Eudocimus mannerheimii* Boh.).

The adults feed on the bark of bald-cypress twigs, causing their death, and the larvæ mine the inner bark of injured and recently felled trees. Southern States.

Exhibit: Adult; section from trunk of living cypress, showing partially healed-over galleries made by larvæ of this beetle which would eventually result in defects in the timber.

SECTION IV.

PHOTOGRAPHS.

Western yellow pine trees killed by the pine-destroying beetle, Black Hills, South Dakota.

Section of yellow pine tree killed by the destructive pine bark-beetle. North Carolina.

Trunk of western yellow pine killed by the Arizona Dendroctonus, showing work of beetles. New Mexico.

Western yellow-pine tree, showing injury caused by the dark-red turpentine beetle at base. New Mexico.

Monterey pine tree, showing injury of the dark-red turpentine beetle at base. California.

Hemlock trees killed in 1892 by the hemlock span-worm. State of Washington.

Trunk of hickory tree killed by the hickory bark-beetle, showing growth of white fungus following attack. Detroit, Mich.

Silver-pine trees killed by the mountain-pine Dendroctonus. Priest River Forest Reserve, Idaho. (2.)

Bark from trunk of giant arborvitæ, showing mines of the cedar bark-beetle. State of Washington.

Log of Douglas spruce, showing galleries of the Douglas spruce Dendroctonus. State of Washington.

Storm-felled Douglas spruce offering favorable conditions for the propagation of the Douglas spruce Dendroctonus and other bark-beetles. State of Washington.

Bark from storm-felled log of Douglas spruce, showing galleries of the Douglas spruce Dendroctonous. State of Washington.

Group of long-leafed pine killed by so-called "worm deadening." Eastern Texas.

Young Sitka spruce, showing top killed by western spruce-weevil. State of Washington.

Cottonwood tree killed by the bronzed Agrilus, showing the galleries of larvæ in trunk. Priest River Forest Reserve, Idaho.

Young chestnut killed by the two-lined chestnut borer. Western North Carolina.

Large chestnut, the death of which was hastened by insect injury. Western North Carolina.

Girdled cypress tree injured by timber beetles. South Carolina.

Trunk of hickory killed by hickory bark-beetle, showing galleries on surface of wood. Western North Carolina.

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PLATE I.

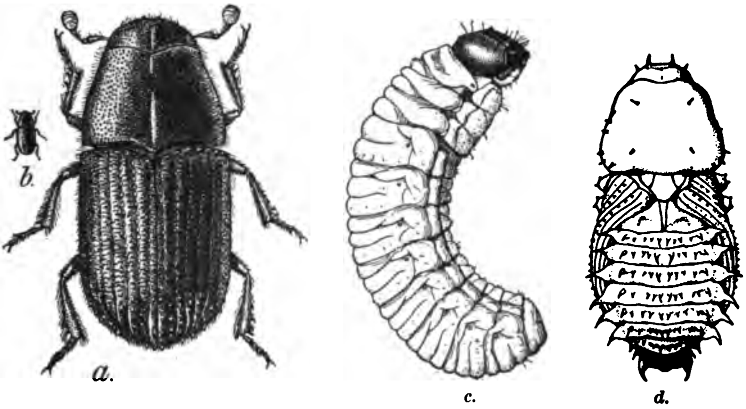


FIG. 1.—THE PINE-DESTROYING BEETLE OF THE BLACK HILLS.

a, Adult beetle, enlarged; *b*, adult beetle, natural size; *c*, larva; *d*, pupa.

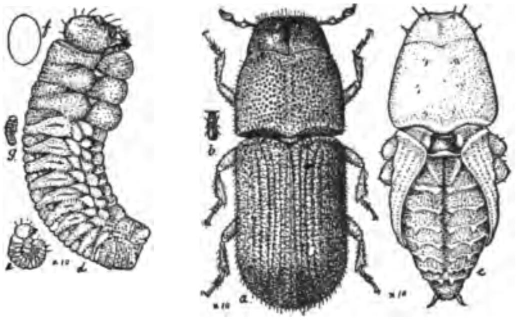


FIG. 2.—DESTRUCTIVE PINE BARK-BEETLE.

a, Adult beetle, enlarged; *b*, adult, natural size; *c*, pupa, enlarged; *d*, larva, enlarged; *e*, young larva, enlarged; *f*, egg, enlarged; *g*, larva, natural size. (After author, in Bulletin No. 56, West Virginia experiment station.)

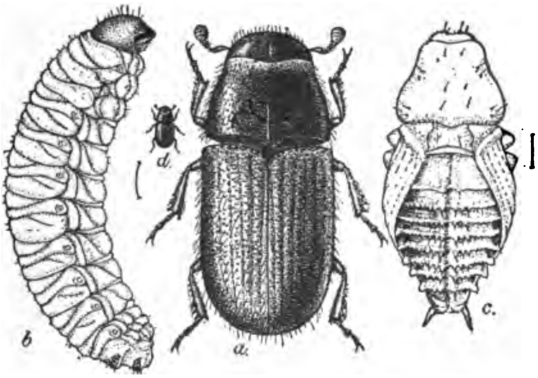


FIG. 3.—SPRUCE-DESTROYING BEETLE.

a, Dorsal view of adult beetle; *b*, side view of larva; *c*, dorsal view of pupa—all greatly enlarged; *d*, natural size of beetle.

(From Yearbook, U. S. Dept. Agriculture, 1902.)

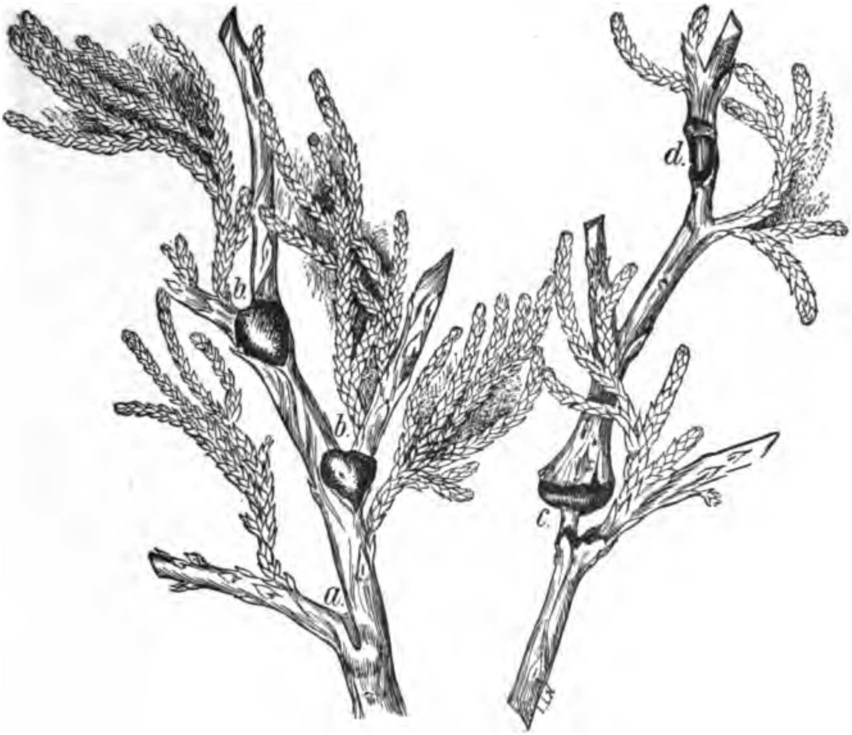


FIG. 1.—WORK OF THE LAWSON'S CYPRESS BARK-BEETLE IN TWIGS OF LIVING TREES.
a, Burrows at base of twig; *b*, *b*, wounds covered with gum; *c*, deformed twig; *d*, wound where twig has died and fallen

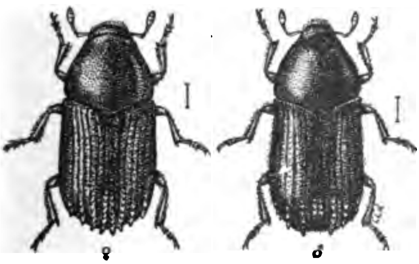


FIG. 2.—THE LAWSON'S CYPRESS BARK-BEETLE: ADULTS, MALE AND FEMALE.

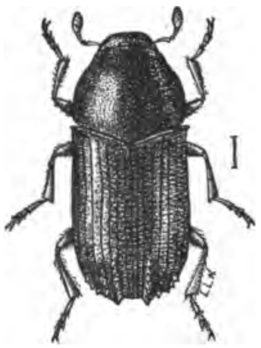
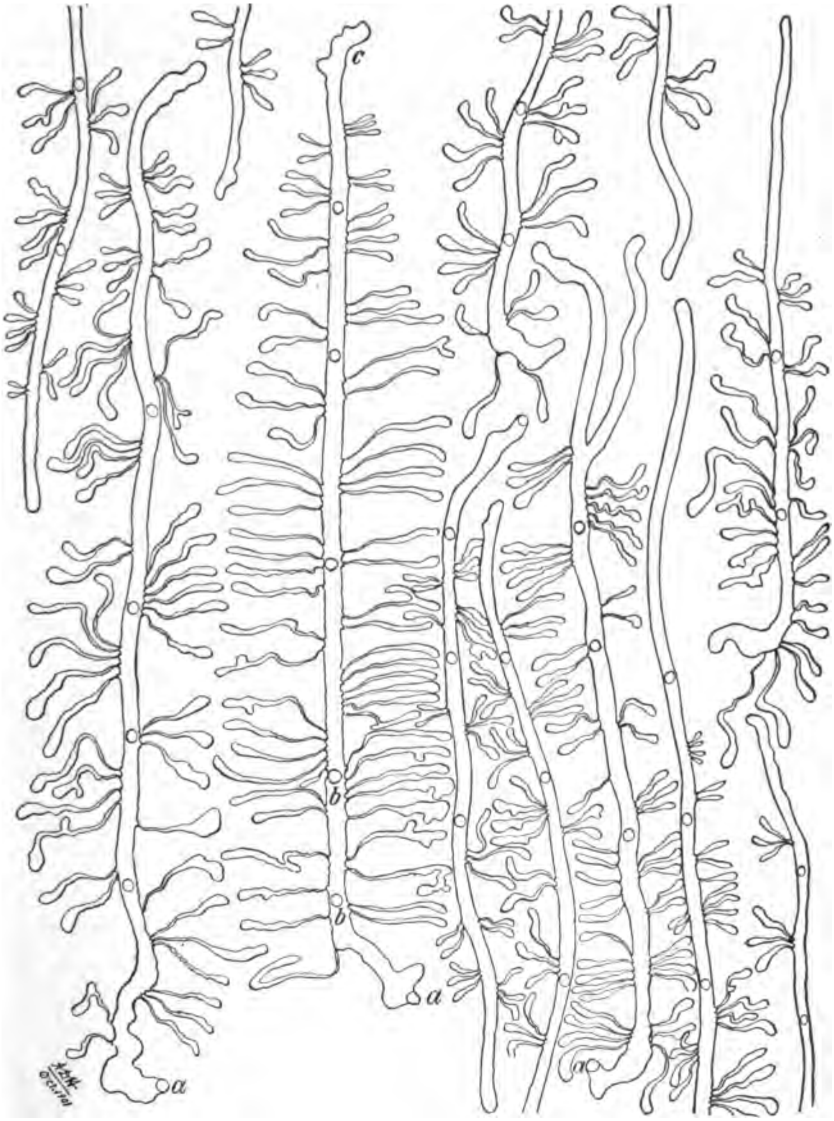


FIG. 3.—THE REDWOOD BARK-BEETLE (PHLŒOSINUS SEQUOIÆ HOPK.): ADULT, ENLARGED.

(From Bul. 38, Bureau of Forestry, U. S. Dept. of Agriculture.)



WORK OF THE PINE-DESTROYING BEETLE OF THE BLACK HILLS. PRIMARY GALLERIES AND LARVAL MINES IN INNER SURFACE OF LIVING BARK.

a, Entrance and basal chamber; *b*, ventilating holes in roof of gallery; *c*, termination. The larval mines radiate from the primary galleries. About one-half natural size. (Author's illustration, Bul. 32, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)

PLATE IV.

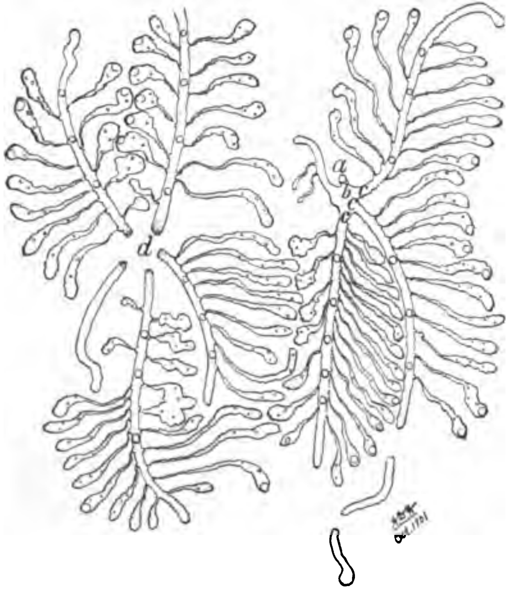


FIG. 1.—WORK OF THE OREGON TOMICUS (TOMICUS OREGONI EICHH.). PRIMARY GALLERIES AND LARVAL MINES IN INNER BARK.

a, Entrance; *b*, central chamber excavated through inner bark; *c*, egg galleries; *d*, location of central chamber not excavated through inner bark. Reduced about one-half. (Original.)

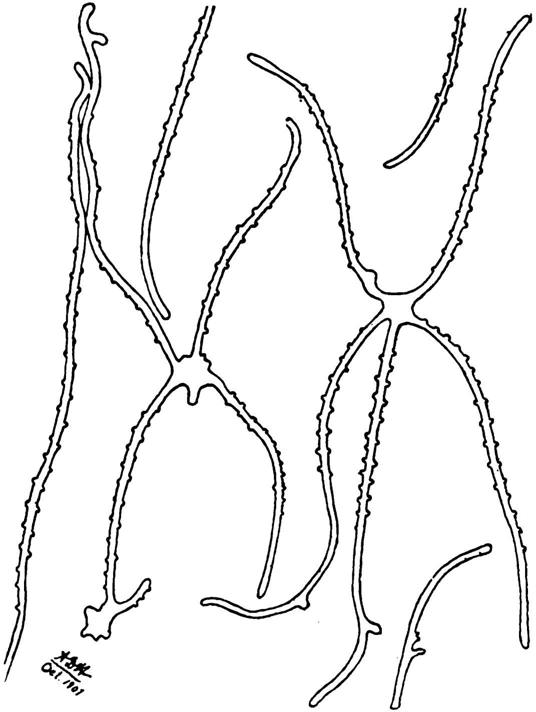


FIG. 2.—WORK OF THE OREGON TOMICUS. PRIMARY GALLERIES ENGRAVED IN SURFACE OF WOOD.

Central chamber extending into wood. Reduced about one-half. (Original.)

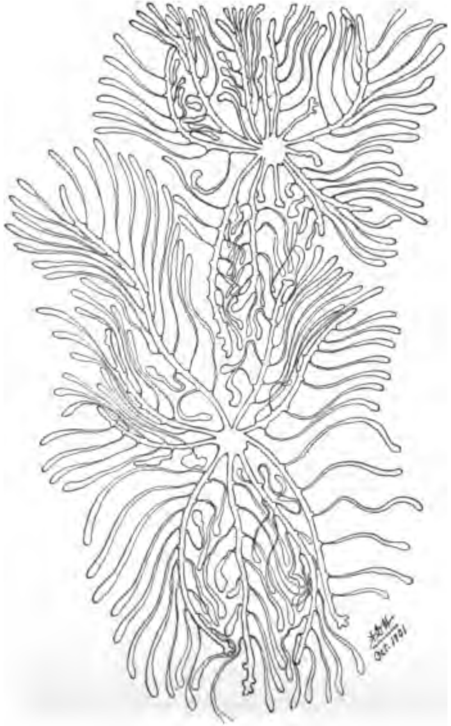
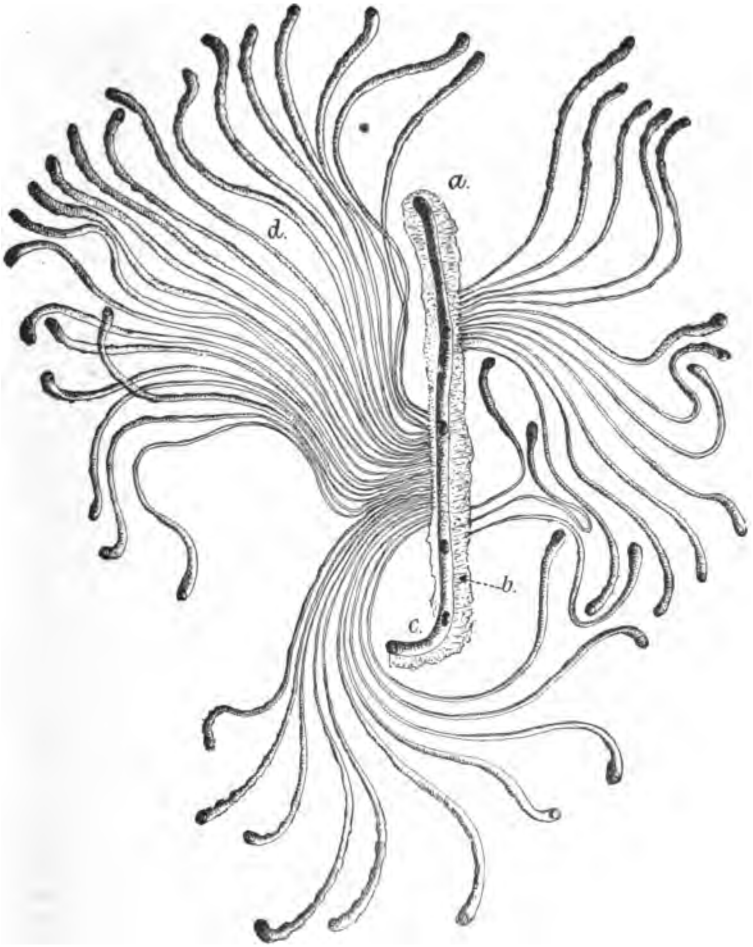


FIG. 3.—WORK OF THE YELLOW PINE WOOD ENGRAVER. PRIMARY GALLERIES AND LARVAL MINES IN INNER BARK AND SURFACE OF WOOD.

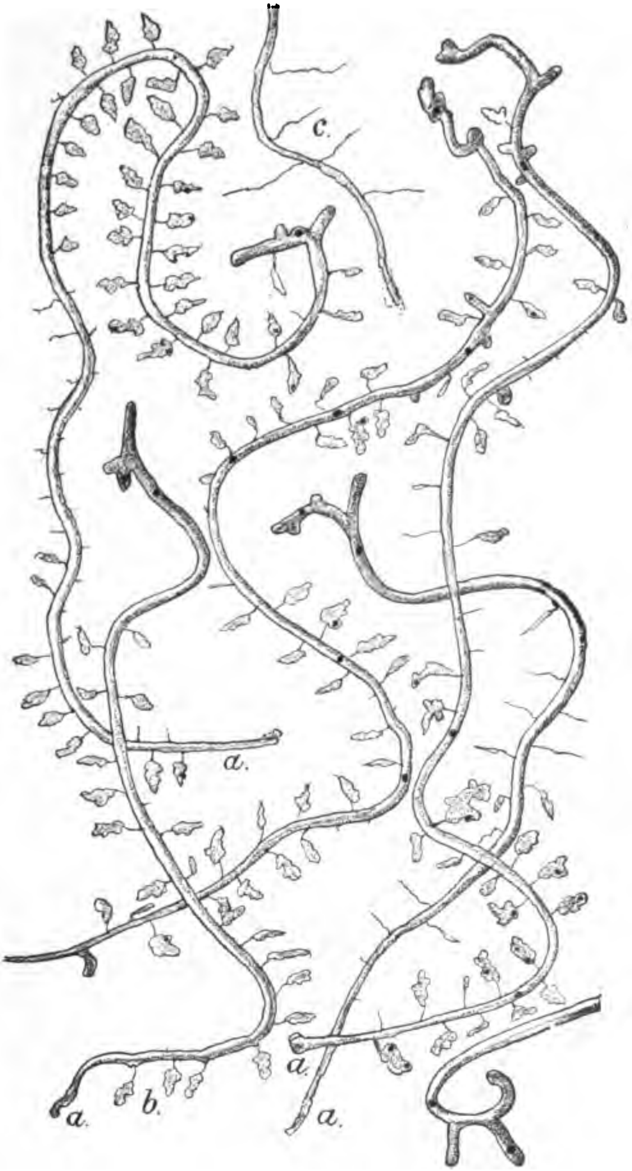
Reduced about one-half. (Original).

(Author's illustrations, Bul. 32, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)



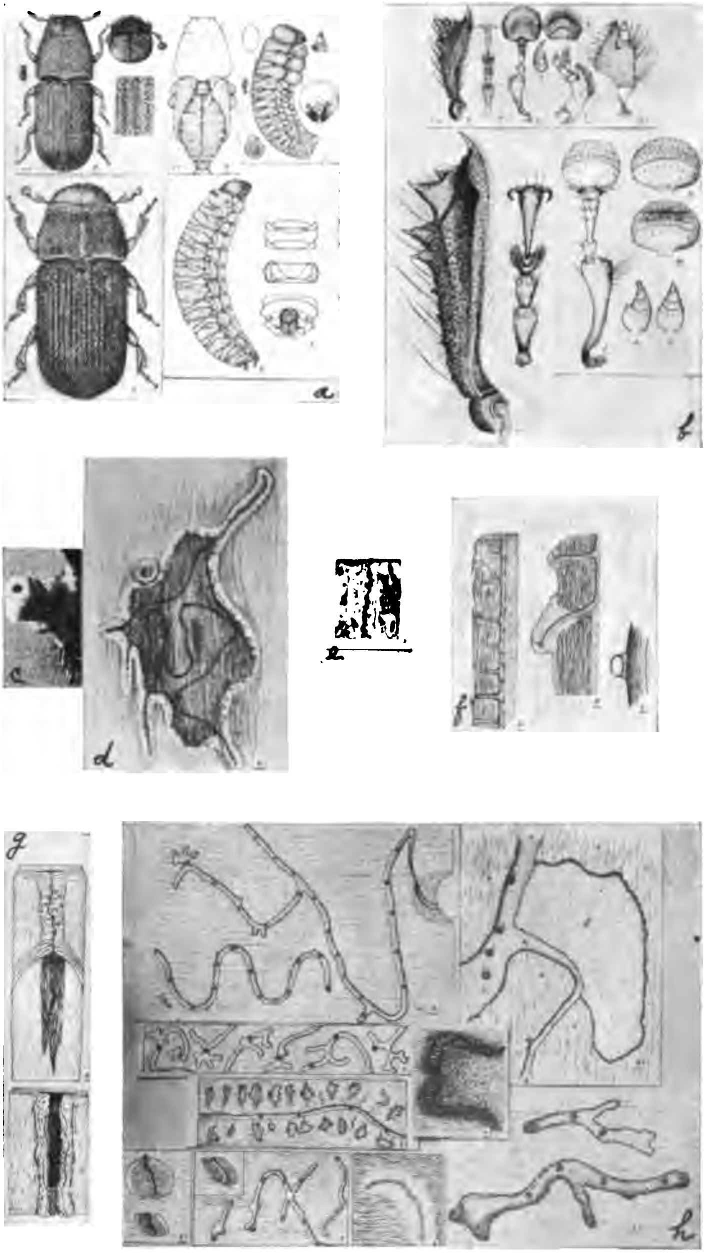
WORK OF THE SPRUCE-DESTROYING BEETLE.

a, Primary gallery; *b*, borings packed in side; *c*, entrance and central burrow through the packed borings; *d*, larval mines. (From Yearbook, U. S. Dept. of Agriculture, 1902.)



WORK OF DESTRUCTIVE PINE BARK-BEETLE.

a, a, a, a, Characteristic forms of primary galleries; *b*, normal forms of larval mines; *c*, abnormal forms of larval mines—all slightly reduced. (Author's illustration, Yearbook, U. S. Dept. of Agriculture, 1902.)



WORK OF DENDROCTONUS FRONTALIS AND DENDROCTONUS TEREBRANS.

a. Dendroctonus frontalis: A, adult; *B*, pupa; *C*, larva; *D*, adult of *D. valens; E*, larva.—*b. D. frontalis: A*, tibia; *B*, tarsus; *C, D. E*, antennæ; *F, G*, mouth parts. *D. valens: H*, Tibia; *I*, tarsus; *J, K, L, M, N*, antennæ, all enlarged.—*c*. Pitch tube made by *D. frontalis*, natural size.—*d*. Healing wounds, from living pine tree, made by *D. frontalis*, reduced.—*e*. Pupa cases of *D. frontalis* in outer pine bark.—*f. D. frontalis: A, B*, Longitudinal section of primary galleries; *C*, egg in egg cavity inside of gallery, the latter enlarged, others reduced.—*g*. Healing wounds in living tree: *E. D. frontalis; F. D. valens*.—*h*. Work of *D. frontalis* in pine bark is shown at *A, C, D, E, F, G;* work of *D. terebrans* in pine bark at *B, H, I;* larva at work at *H*. Both *D. frontalis* and *D. terebrans* attack spruce. (From Bul. 28, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)

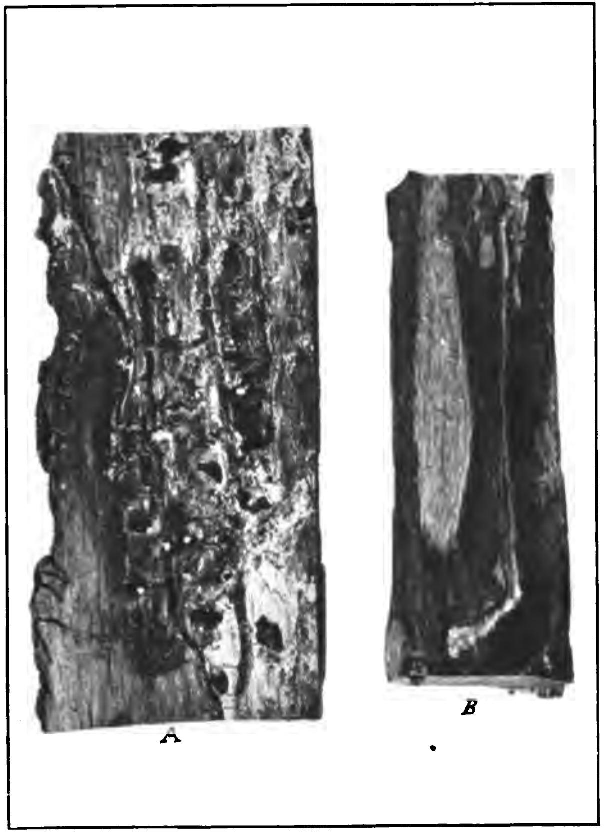


Fig. 1.

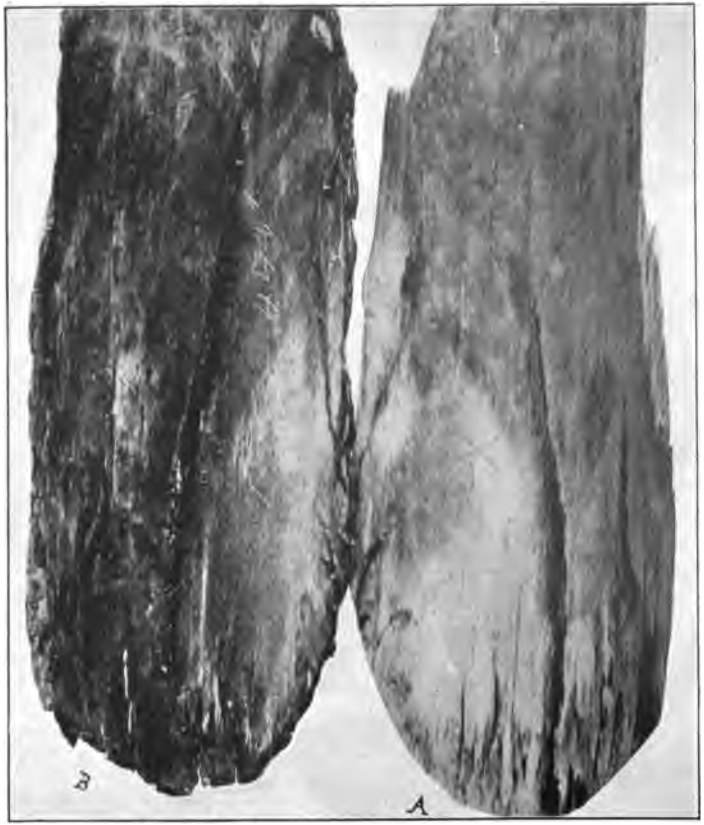


Fig. 2.

WORK OF THE PINE-DESTROYING BEETLE OF THE BLACK HILLS.

Fig. 1. *A*, Primary galleries, larval mines, pupa cases, and exit holes in bark; *B*, primary galleries grooved in surface of wood in chip cut from railroad tie. (Original.)—Fig. 2. *A*, Scoring chip from railroad tie, showing surface of wood not marked by insects; *B*, inner surface of bark from same chip. About (Author's illustration. Bul. 32, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)

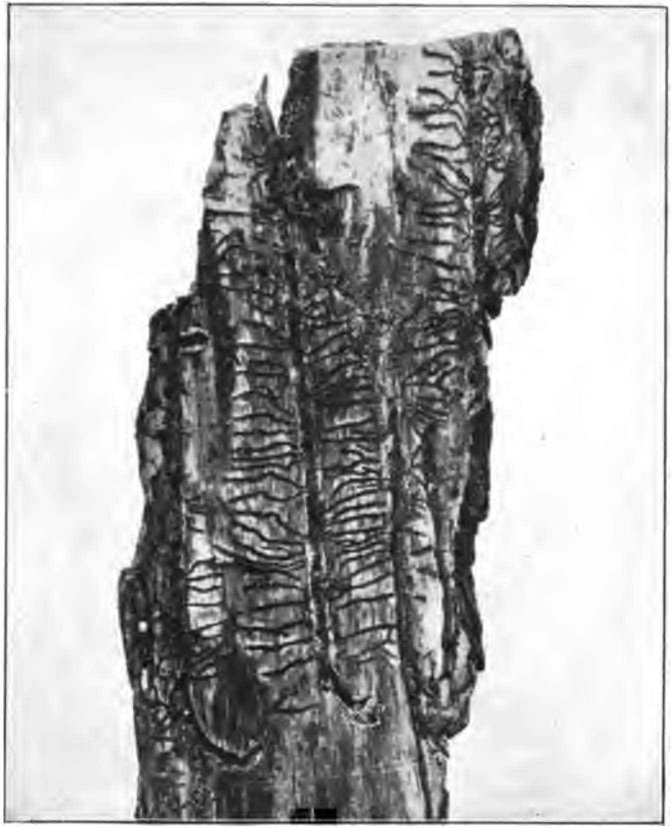


Fig. 1.

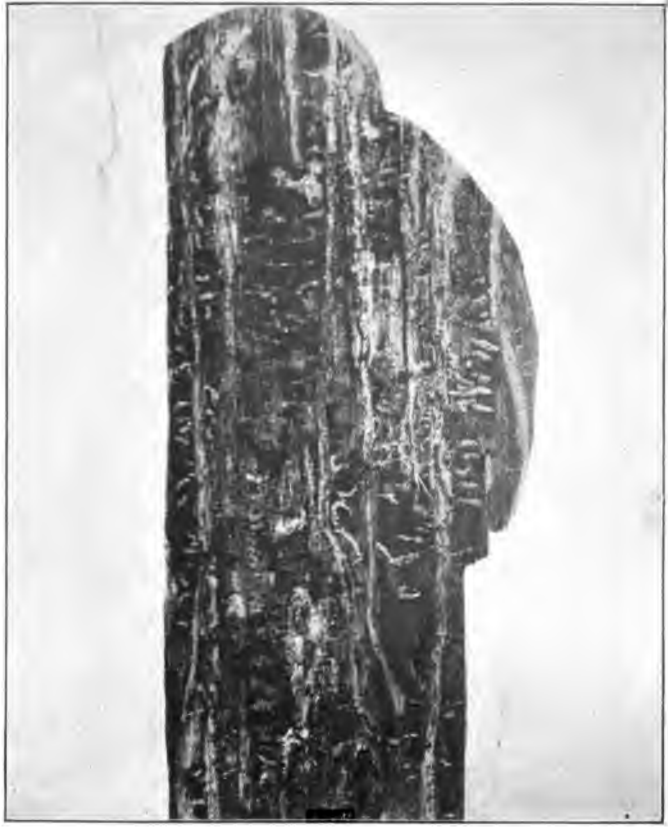


Fig. 2.

WORK OF THE PINE-DESTROYING BEETLE OF THE BLACK HILLS.

Fig. 1. Primary galleries and larval mines in inner bark. About one-third natural size. (Original.)—Fig. 2. Marks of primary galleries on surface of scoring chip from railroad tie. About one-third natural size. (Author's illustration, Bul. 32, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)

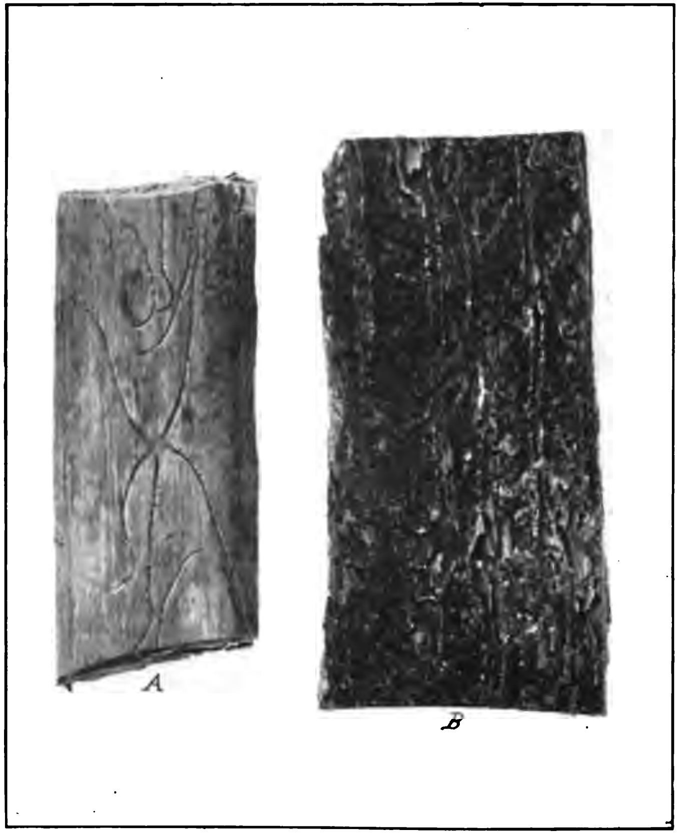


Fig. 1.

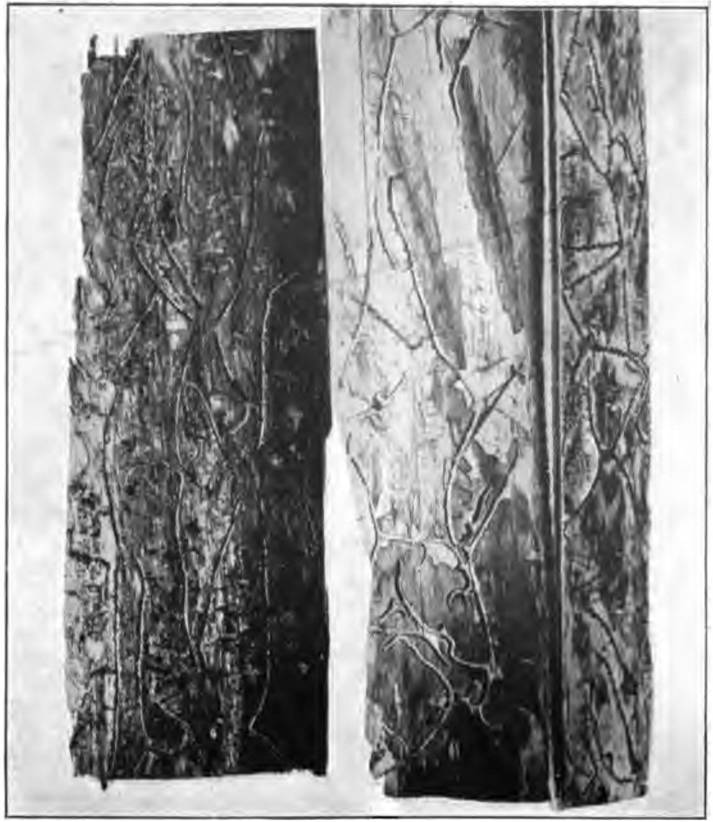


Fig. 2.

WORK OF THE OREGON TOMICUS.

Fig. 1. *A*, Galleries engraved in surface of wood cut from old dead tree; *B*, bark with inner portion destroyed by galleries and larval mines. About one-third natural inner bark and surface of wood of railroad ties and edging strips. About one-third natural size. (Author's illustration, Bul. 32, n. s., Div.

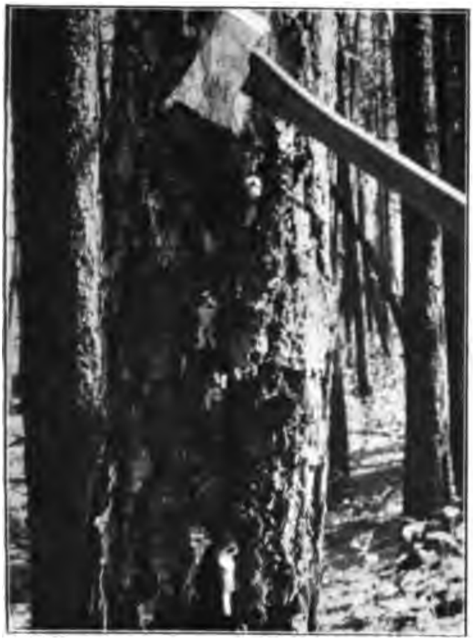


Fig. 1.

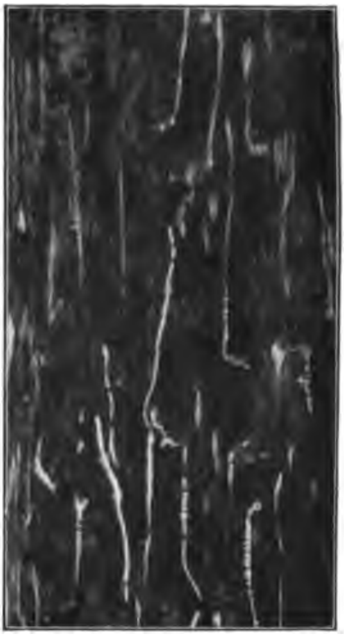


Fig. 2.

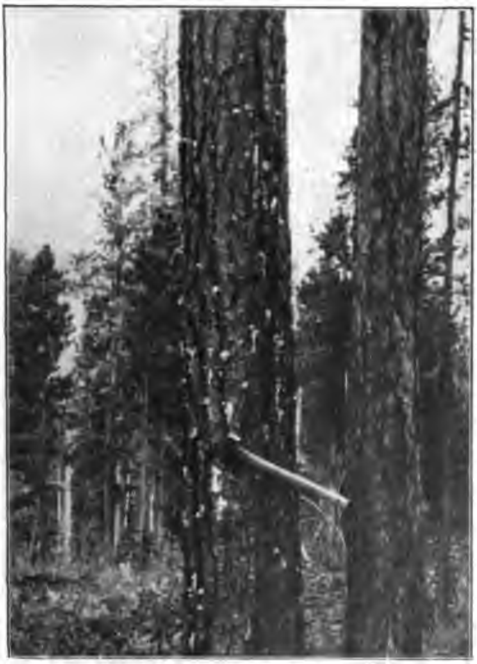


Fig. 3.

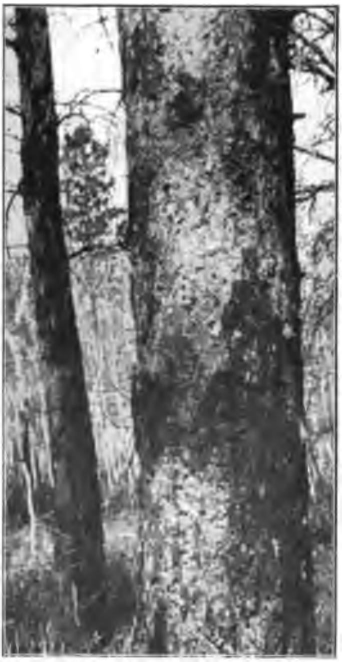


Fig. 4.

WORK OF THE PINE DESTROYING BEETLE OF THE BLACK HILLS FOREST RESERVE.

Fig. 1. Small freshly attacked pine tree, showing pitch tubes.—Fig. 2. Marks of primary galleries on the surface of wood when bark is removed.—Fig. 3. Freshly attacked tree, showing pitch tubes. Adjoining tree not attacked.—Fig. 4. Dead tree; outer bark removed by woodpeckers. (From Bul. 32, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)

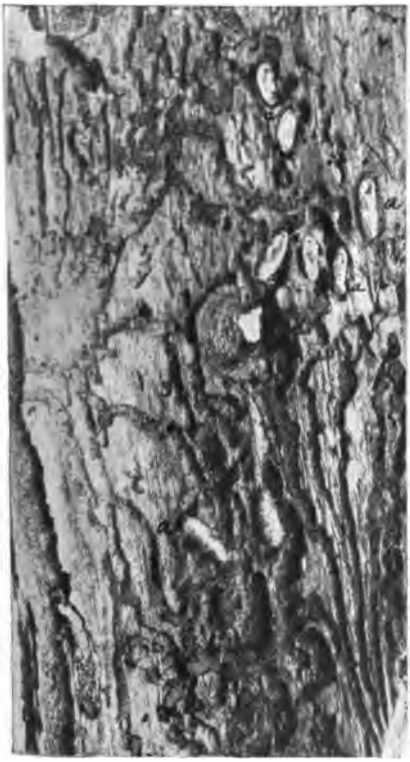


FIG. 1.—COCOONS OF BRACON SIMPLEX, A PARASITE OF THE SPRUCE-DESTROYING BEETLE.

The cocoons of *Bracon simplex*, in the larval mines of *Dendroctonus piceaperda*, are shown at *a*. (From Bul. 28, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)

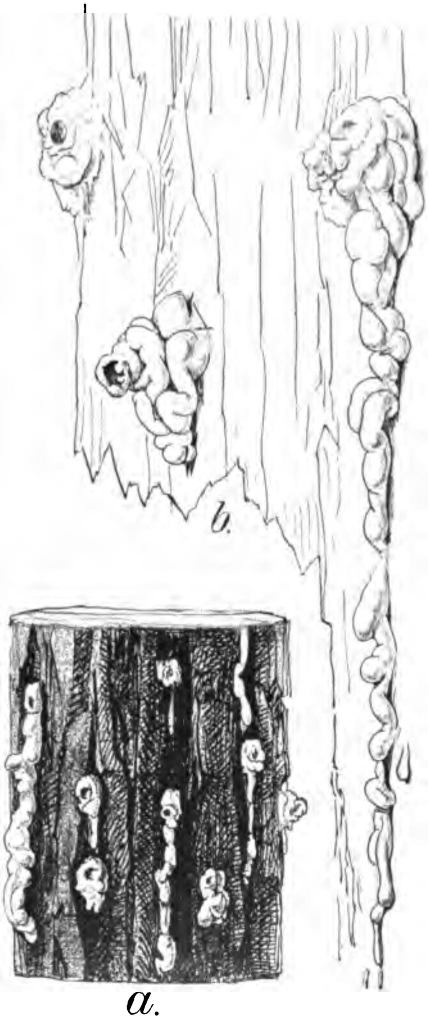
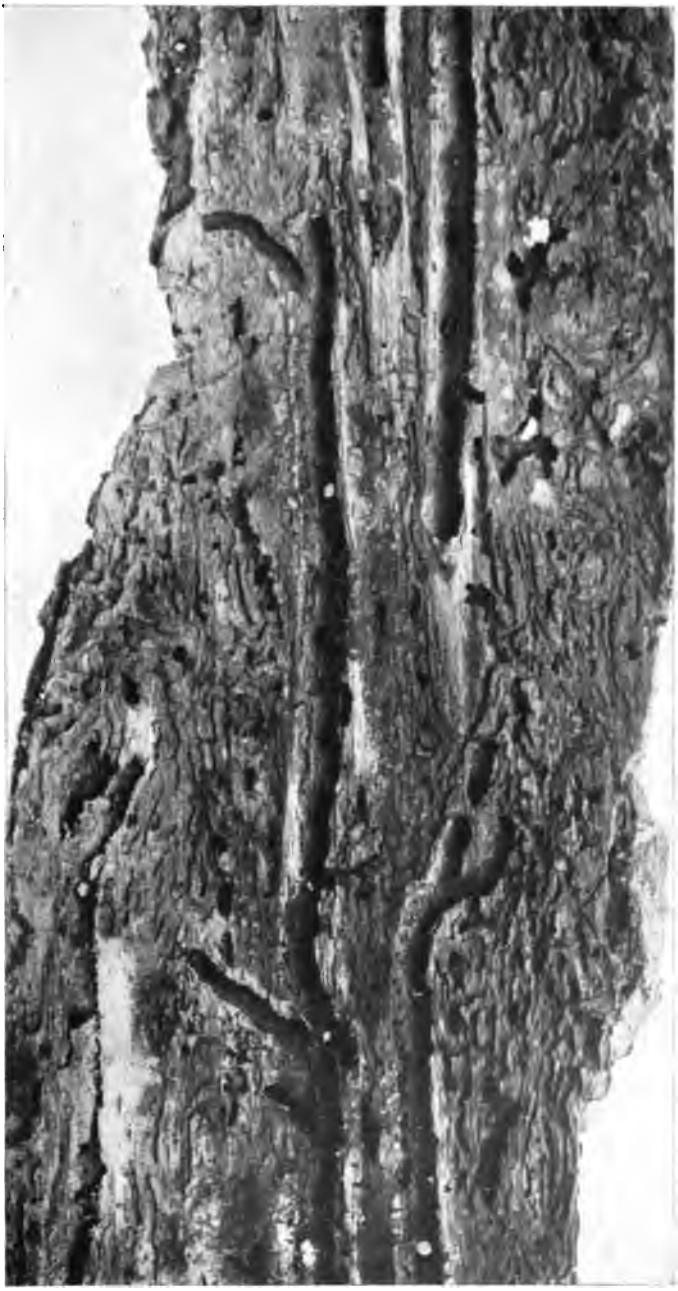


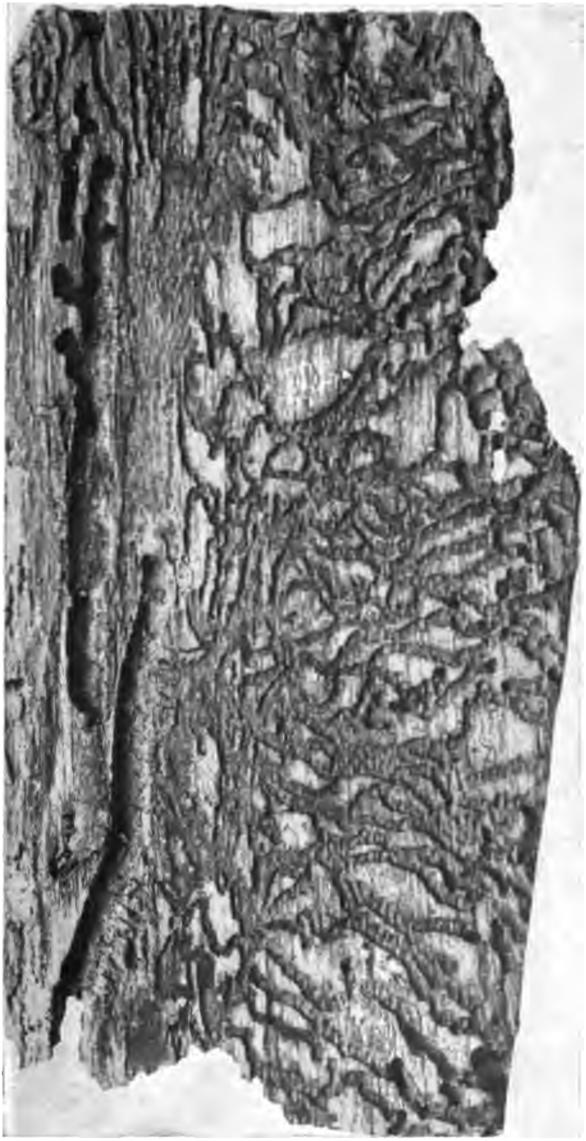
FIG. 2.—WORK OF THE PINE-DESTROYING BEETLE OF THE BLACK HILLS.

a, Pitch tubes on surface of bark, much reduced; *b*, same, two-thirds natural size. (From Yearbook, U. S. Dept. of Agriculture, 1902.)

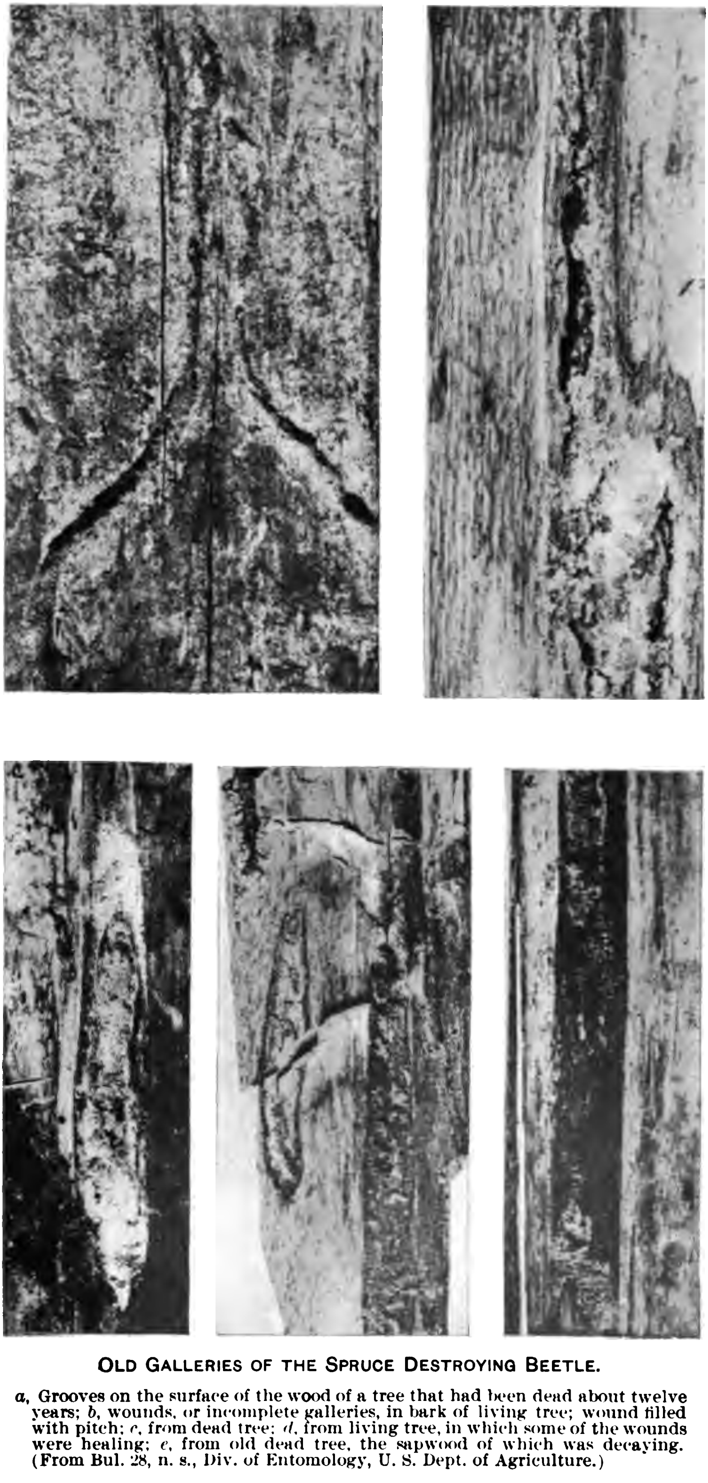


GALLERIES AND MINES OF THE SPRUCE-DESTROYING BEETLE.

Showing parts of six primary galleries, reduced about one-fourth. (From Bul. 28, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)

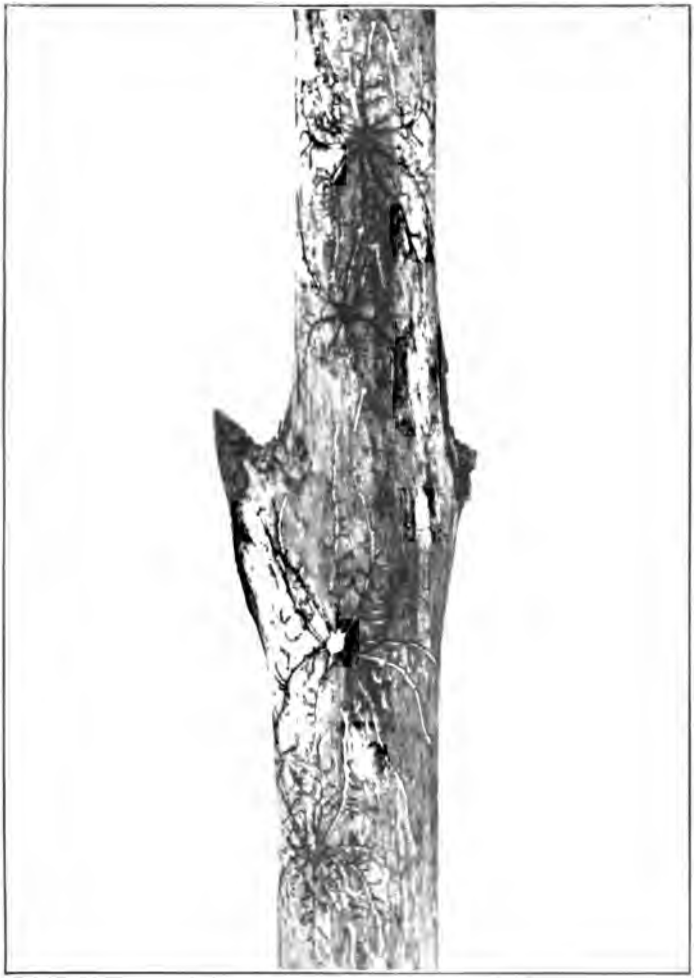


GALLERIES AND MINES OF THE SPRUCE DESTROYING BEETLE.
(From Bul. 28, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)



OLD GALLERIES OF THE SPRUCE DESTROYING BEETLE.

a, Grooves on the surface of the wood of a tree that had been dead about twelve years; *b*, wounds, or incomplete galleries, in bark of living tree; wound filled with pitch; *c*, from dead tree; *d*, from living tree, in which some of the wounds were healing; *e*, from old dead tree, the sapwood of which was decaying. (From Bul. 28, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)



WORK OF THE YELLOW PINE WOOD ENGRAVER. GALLERIES IN INNER BARK AND SURFACE OF WOOD.

About one-third natural size. (Author's illustration, Bul. 32, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)

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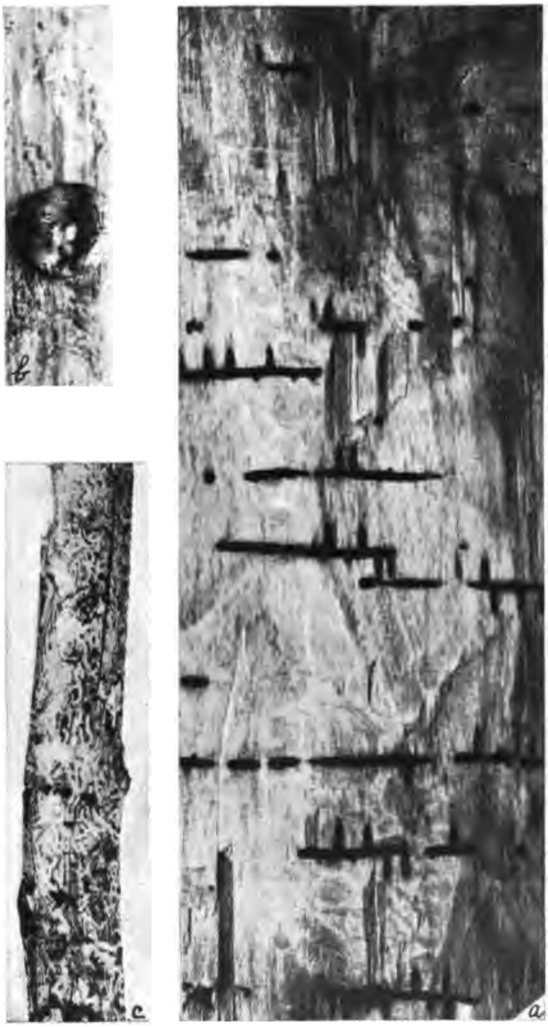
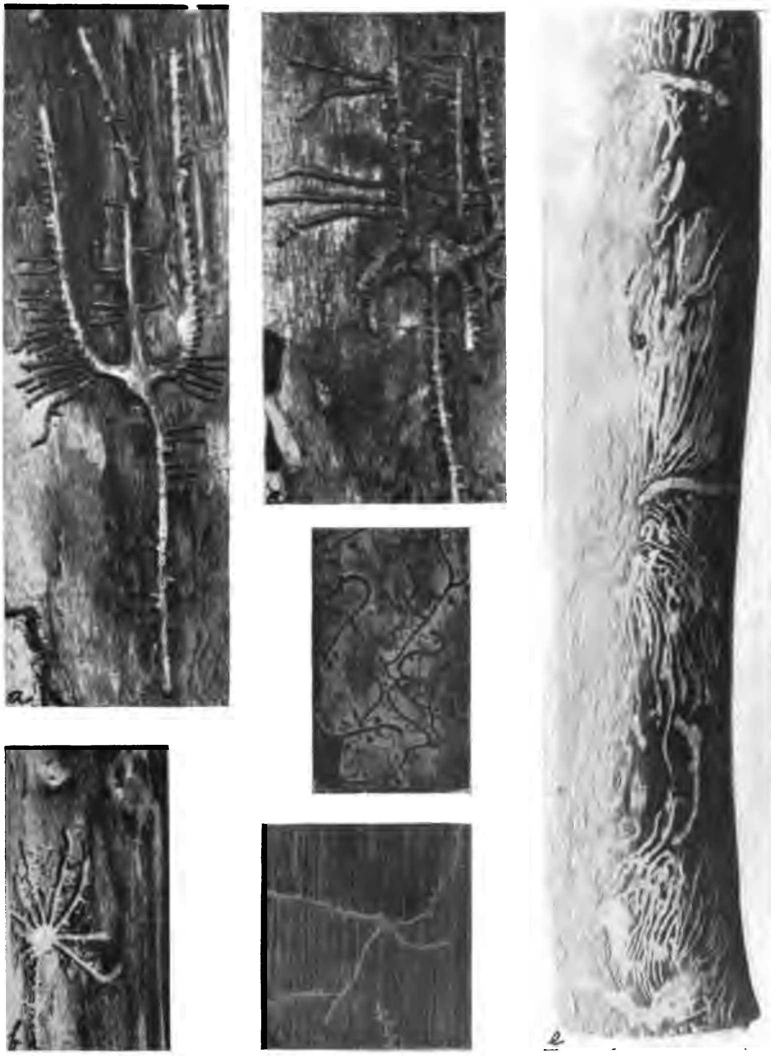


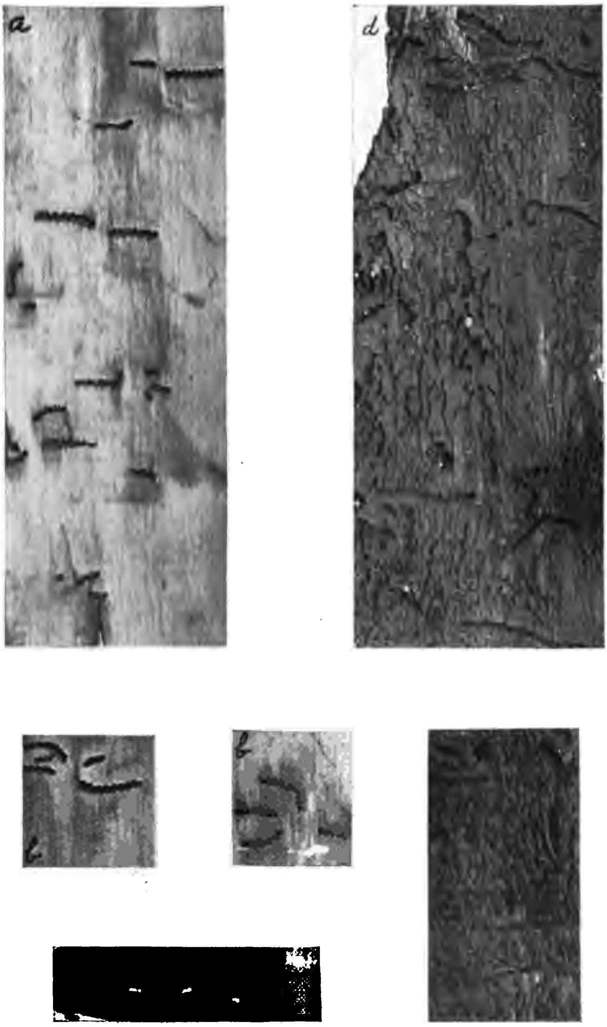
WORK OF TIMBER AND BARK-BEETLES IN SPRUCE.

a, Work of the spruce timber-beetle in the sapwood of spruce, natural size; *b*, fungus (*Polyporus volvatus*) growing from mines of spruce timber-beetle on the surface of the wood after the bark had been removed, natural size; *c*, work of *Phlœotribus piceæ* Hopk. MS. in spruce. (From Bul. 28, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)



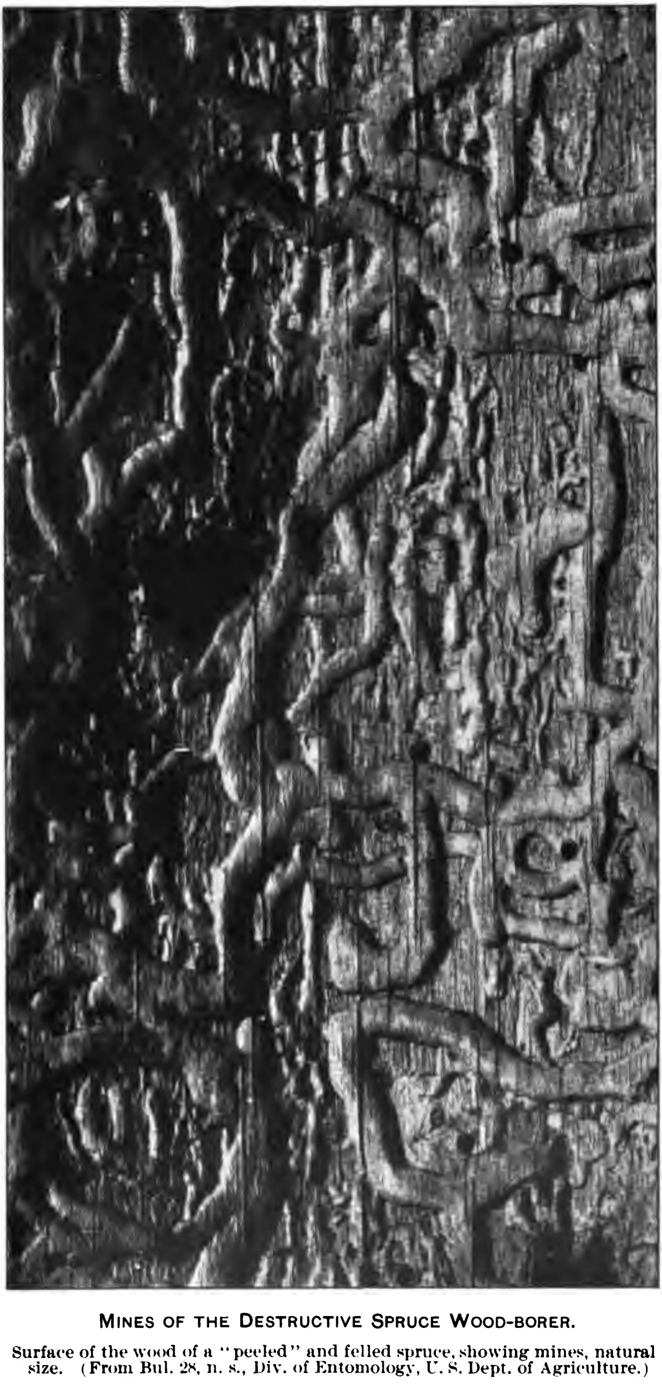
WORK OF SECONDARY AND OTHER ENEMIES OF SPRUCE.

a, Work of the white spruce bark-beetle (*Tomicus*) in white spruce bark; *b*, work of spruce wood-engraver (*Pityophthorus cariniceps* Lec.) in spruce bark and grooving the outer wood; *c*, galleries of the destructive pine bark-beetle (*Dendroctonus frontalis*) in pine bark; also attacks spruce; *d*, work of the small red spruce bark-beetle (*Dryocœtes* n. sp.) on the surface of spruce wood; *e*, galleries of the spruce bark-beetle (*Polygraphus rufipennis* Kirby) on surface of pieces of spruce driftwood, found in Parmacheene Lake. (From Bul. 28, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)



GALLERIES OF THE SPRUCE BARK-BEETLE, SHOWING DIFFERENT STAGES.

a, *b*, *c*, Freshly excavated galleries in living bark; *d*, old galleries in dead bark. (From Bul. 28, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)



MINES OF THE DESTRUCTIVE SPRUCE WOOD-BORER.

Surface of the wood of a "peeled" and felled spruce, showing mines, natural size. (From Bul. 28, n. s., Div. of Entomology, U. S. Dept. of Agriculture.)

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